Fisheries Monitoring in the Upper Clark Fork River Basin
2024 Report

Prepared By:

Tracy Elam, Caleb Uerling, Pat Saffel and Brad Liermann

Montana Fish, Wildlife and Parks

Region 2, Fisheries Division

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Abbreviations for fish species present in the Upper Clark Fork River.

Species	Species abbreviation
Brook Trout	EB
Brook Trout X Bull Trout Hybrid	EBxBULL
Brown Trout	LL
Brook Trout X Brown Trout Hybrid	EBxLL
Bull Trout	BULL
Central Mud Minnow	CM MN
Kokanee	KOK
Lake Trout	LT
Largemouth Bass	LMB
Largescale Sucker	LS SU
Longnose Sucker	LN SU
Longnose Dace	LN DC
Mountain Whitefish	MWF
Northern Pike Minnow	N PMN
Rainbow Trout	RB
Rainbow Trout X Westslope Cutthroat Trout	RBxWCT
Redside Shiner	RS SH
Rocky Mountain Sculpin	RM COT
Sculpin (unidentified)	COT
Columbia Slimy Scuplin	SL COT
Westslope Cutthroat Trout	WCT
Yellow Perch	YP

Introduction

The Upper Clark Fork River (UCFR) was subject to extensive mining and mineral processing activities during the late 19th and early 20th centuries. Metal contamination has reduced habitat quality and altered the fishery in the UCFR. Fishery changes include reduced trout numbers and changes in species composition. Because of these negative impacts, angling use of the Clark Fork River is lower compared to other rivers in western Montana. Extensive remediation and restoration efforts are underway, and these efforts aim to mitigate historical mining and smelting damage to natural resources in the Upper Clark Fork River Basin (UCFRB). Effects of these actions have been dramatic in Silver Bow Creek, where remedial activities have allowed the return of trout after being extirpated for more than a century (Naughton 2013). The Silver Bow Creek fishery may continue to change in response to improvements in water quality, maturation of riparian vegetation, natural changes in river morphology, tributary restoration projects, flow enhancements, etc. Remedial efforts on the mainstem of the Clark Fork River are more recent and the area slated for restoration projects is vast (see Saffel et al. 2018). Thus, monitoring fisheries responses to restoration needs to be done at multiple spatial and temporal scales (Geum Environmental 2015).

Fisheries data collection was conducted sporadically in the UCFRB in the past. Starting in 2008, FWP biologists began establishing seven long term monitoring sections on the mainstem UCFR. FWP has completed population estimates in these seven sections each of the subsequent years. These mainstem population surveys provide a dataset that can be used to evaluate the mainstem Clark Fork River fishery before, during, and after restoration and remediation actions. Annual fisheries surveys in Silver Bow Creek began as early as 2002 when the first suckers and sculpin were detected at the Rocker section. Silver Bow Creek surveys initially consisted of one-pass electrofishing conducted in the fall. More sections were added in 2014, and sampling occurred in both spring and fall. The first fish population estimates were attempted on Silver Bow Creek in 2015, both in spring and fall. The spring sampling was shifted to summer from 2016-2018 and population estimates were conducted in summer and fall at six sections. The summer sampling is conducted during low flows and high-water temperatures. Low dissolved oxygen has been documented in the past during the summer and hypoxic areas of Sliver Bow Creek tend to be devoid of trout during this period (Naughton 2013). Fall sampling is focused on evaluating fish numbers and distribution when water temperatures have cooled, and dissolved oxygen concentrations are more favorable to fish.

Multiple tributaries have been identified as priorities for restoration in the UCFRB (Saffel et al., 2018). Preliminary data on species composition and distribution were collected in multiple watersheds during the late 2000s (Lindstrom et al. 2008, Liermann et al. 2009). Population estimate sections were established in priority tributaries and these sections were sampled every year from 2015-2017. Larger streams (Warm Springs Creek, Little Blackfoot River, and Flint Creek) are now sampled once every two to three years, while smaller tributaries are sampled periodically.

As restoration projects have been completed in the tributaries, there has been increased opportunities to evaluate these projects and their fisheries benefits. However, due to the sheer number of restoration projects in the UCFRB, not all projects can be specifically monitored. This limitation requires the careful

prioritization of project-level monitoring efforts. Project monitoring to date has focused on getting pre- and post- project fisheries data on large projects (i.e., the Allendale Canal), gathering data on different restoration approaches, or evaluating the potential for projects to provide benefits to fish. We describe project level monitoring in Spotted Dog Creek, Cottonwood Creek and at the Allendale Canal fish screen project in this report.

Clark Fork River Mainstem

Population surveys

Trout population estimates are usually conducted in spring at seven established sections on the Clark Fork River. These sections are sampled annually by FWP and are referred to as Bearmouth, Morse Ranch, Phosphate, Williams Tavenner, Below Sager Lane, pH Shack to Perkins Lane, and pH Shack (Map 1). Other sections have been added as remediation has progressed and some sites aren't monitored every year because there is not enough time during the sampling season to sample all sections. The sections completed in 2024 were pH Shack, Racetrack Bridge to Huey Long's, Below Sager Lane, Kohrs Manning diversion to Wastewater Plant, Williams Tavenner, Phosphate, Morse Ranch and Bearmouth.

Fish were collected using drift boats with a mounted electrofishing unit, two front boom anodes and one netter. Estimates were made using two marking runs and two recapture runs. Recapture runs were completed one week after marking runs. All captured trout were identified to species, weighed (g), measured (mm), and marked with a small fin clip. Population estimates for fish ≥ 175 mm (~7 in) were generated using the Chapman modification (Chapman 1951) of the Petersen method provided in Montana Fish, Wildlife and Park's Fisheries Information System. Estimates were calculated for trout species that had a minimum of 4 marked fish recaptured (B. Liermann, Montana, Fish, Wildlife, and Parks, personal communication, 2014). The pH Shack section was sampled with different gear starting in 2023 to assess the population of fish less than 175 mm. Instead of the normal drift boat electrofishing, a small barge unit was used. This set up used two mobile electrodes, two netters and one barge operator. This allowed for more targeted sampling of smaller fish while still allowing the capture of larger fish. Two marking runs and two recapture runs were conducted.

<u>Annual Sections</u>

Six of the seven long-term monitoring sites were sampled in 2024. These sites have been sampled annually since 2008 and 2009 (Figures 3 and 4). For the pH Shack section, estimates were produced two different ways. The first estimate is for all fish greater than 175 mm pooled together. The brown trout estimate for 2024 was 26(16-49) fish/km which is up from 19(12-35) fish/km in 2023. The 2023 estimate was the lowest ever observed dating back to the 1970's. The use of the small barge allowed us to produce estimates for fish between 75-174 mm. The 2024 brown trout estimate was 222(182-277) fish/km which is down from 372(251-569) fish/km in 2023. Around 2/3 of those fish were in the 75-124 mm length group for both years (Figure 1). Using the age data from an otolith microchemistry study that was completed in 2023, we were able to estimate the number of fish per km per age class from the barge electrofishing data. A comparison between 2023 and 2024 are shown in Figure 2.

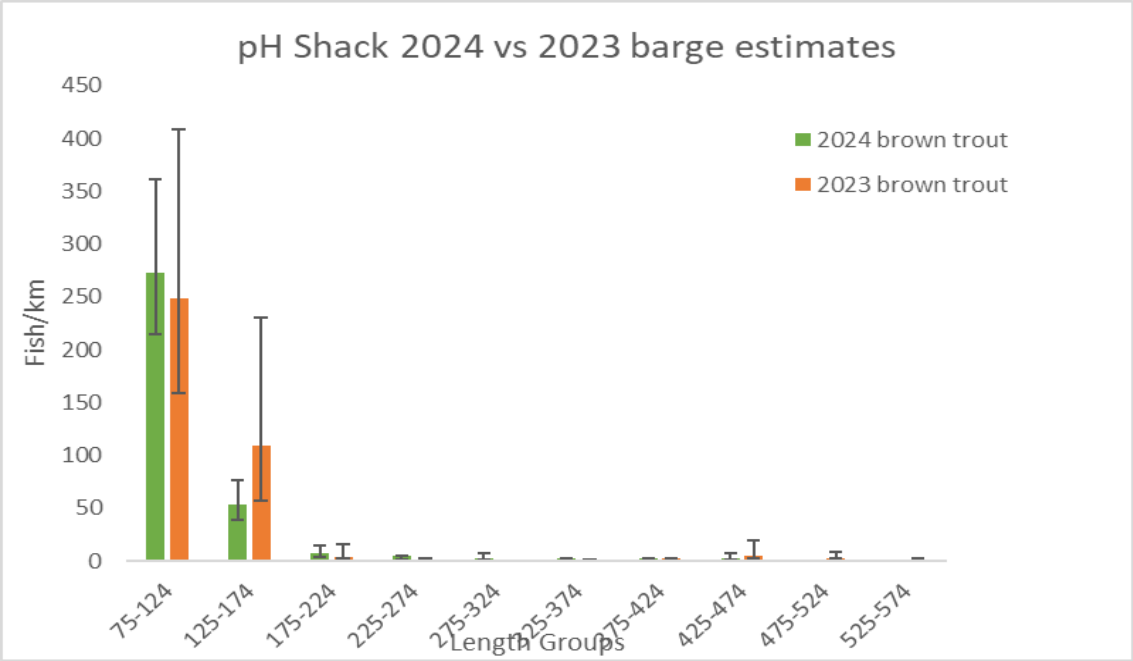


Figure 1. Comparison of the brown trout estimates from 2023 and 2024 using the tote barge.

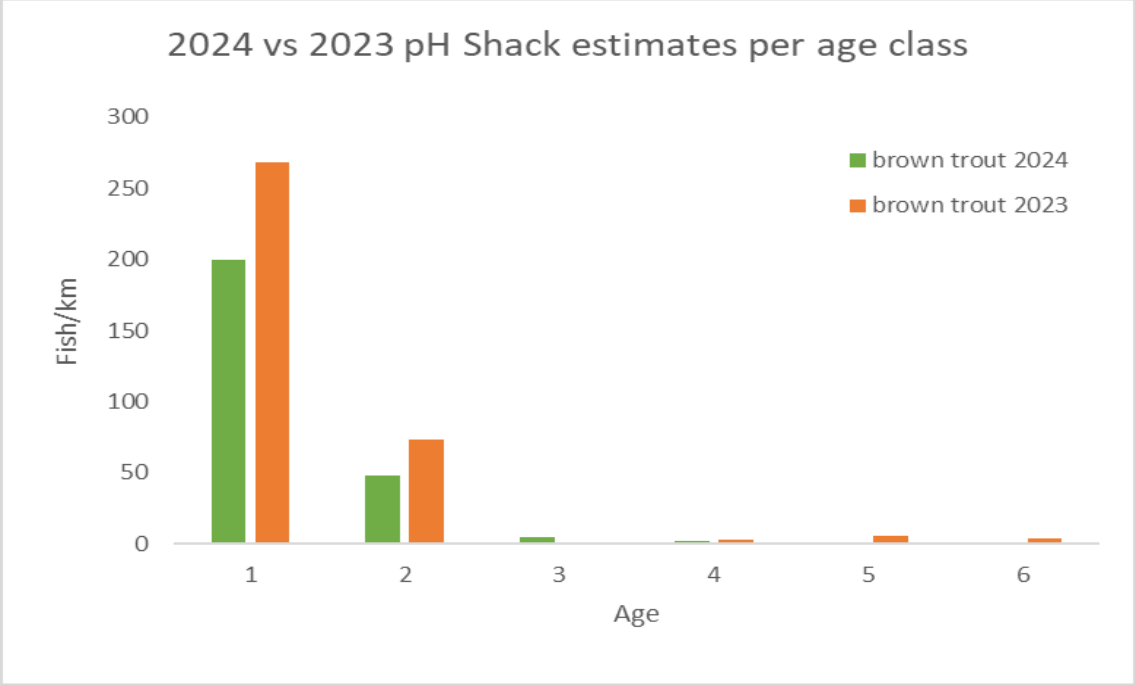


Figure 2. Population estimates for 2023 and 2024 of fish per age class using otolith age data from the brown trout microchemistry data.

The remainder of the long-term monitoring sections were done using the same techniques as past years. A section from Racetrack Bridge to Huey Long's was surveyed in 2024 and hadn't been done since 2015. The 2024 estimate was 38(18-96) fish/km compared to 2015 when the estimate was 132(89-202) fish/km. The Below Sager Lane section brown trout estimate for 2024 was 151(67-362) fish/km, up from 56(40-81) fish/km in 2023. This is near the long-term average (142 fish/km) and almost double the five-year average (82 fish/km). The brown trout estimate for the Kohrs Manning diversion to Wastewater plant for 2024 was 70(36-149) fish/km. No estimate was produced in 2023 due to poor sampling conditions and low efficiency. The last estimate for this section was in 2022 and was 132(70-267) fish/km. The Williams-Tavenner section brown trout estimate for 2024 was 171(105-297) fish/km, up from 140(99-204) fish/km in 2023. This is near the long-term average (183 fish/km) and higher than the five-year average (148 fish/km). The Phosphate section brown trout estimate for 2024 was 176(125-254) fish/km, up from 116(88-160) fish/km in 2023. This is below the long-term average (193 fish/km) but above the five-year average (151 fish/km). The Morse Ranch section saw a decrease in the brown trout estimate in 2024 with 71(56-91) fish/km down from 115(96-141) fish/km in 2023. This is below both the long-term average (84 fish/km) and the five-year average (81 fish/km). We were also able to produce a Westslope cutthroat trout estimate of 8(3-19) fish/km up from 5(3-9) fish/km in 2023. The Bearmouth section brown trout estimate for 2024 was 52(40-67) fish/km, up from 33(24-47) fish/km in 2023. This is above the long term (33 fish/km) and five-year average (38 fish/km). The combined Oncorhynchus estimate in the Bearmouth section for 2024 was 54(40-75) fish/km, up from 43(33-57) fish/km in 2023. The rainbow trout estimate was 37(25-59) fish/km and the westslope cutthroat trout estimate was 17(11-27) fish/km.

Discussion

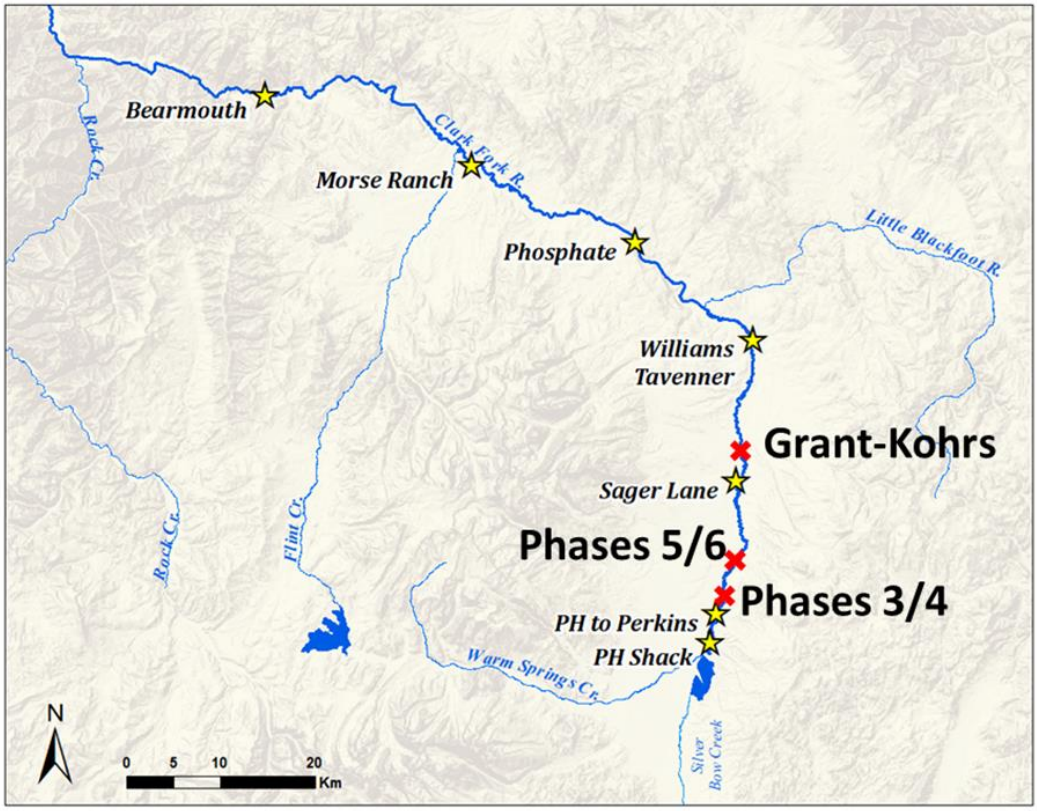
The brown trout densities in the UCFR upstream of Deer Lodge continue to be near historic lows. Estimates in the Below Sager Lane section rebounded in 2024 after the lowest ever for that reach in 2023. It should be noted that the 2024 estimate for Sager Lane was impacted by low capture efficiency on the re-capture run and the confidence intervals for the estimate suggest it may not be very accurate. Fewer fish were marked, and fewer fish were handled overall in 2024 compared to the previous two years. The numbers for the pH Shack section were higher than the previous year but still near the lowest on record for that reach. The Kohrs Manning diversion to Wastewater plant section appears to be seeing declines relative to past estimates, however historic data is very limited. The declines seen at Kohrs Manning may be in line with declines that would be expected from habitat disturbance associated with past remediation strategies. This section was started in 2018 and has been surveyed regularly since then, but some samples were taken in the fall and are not believed to be an accurate reflection of numbers of resident fish in the section. The second lowest estimate since beginning this section was the 2024 estimate. Whatever is causing the population crash in the upper river seems to be having less of an impact below Deer Lodge. Estimates for Williams Tavenner and Phosphate are both near the long-term average and above the five-year average. The Morse Ranch section near Drummond had been above the long-term and five-year average the last two years but fell below both in 2024. This does seem to be a common pattern for this section since sampling was started in 2009 (Figure 3). The Bearmouth section has been above the long-term and five-year average for the last three years. The cause for the population crash is not fully understood. Based on an otolith microchemistry study (Cook et al. 2017), the brown trout population upstream of Deer Lodge is heavily dependent on recruitment of

fish that were spawned and reared in the mainstem Clark Fork River. Historically, variations in the brown trout population in the upper reaches of the UCFR were tied to flows. Prior to 2018, the number of age 3 fish captured during electrofishing (an index of recruitment) at the pH Shack Section was strongly related to flow conditions three years prior. Variability in recruitment of age 3 brown trout from 2002 to 2017 could be explained by minimum flow conditions three years prior (r^2=0.85). However, since 2018, minimum flow conditions are no longer a strong predictor of brown trout recruitment in the UCFR.

A repeat of some of the 2017 brown trout otolith microchemistry study (Cook et al. 2022) was conducted in 2023. Preliminary results suggest that survival of fish that were spawned in the mainstem Clark Fork River is less than 10%. Of the 108 brown trout collected upstream of Deer Lodge for the study, only seven assigned to the Clark Fork River mainstem. The fish that assigned to the river were age two and three, so there has been some survival of river spawned fish in the past few years. Although it was a small sample size, of the 16 age one fish collected, none assigned to the river. More age one fish were collected in the pH and Sager Lane sections in the spring of 2024 to bolster the sample size. Those otoliths are currently being prepped and will be sent to Woods Hole Oceanographic Institute for analysis.

Coinciding with the decline in brown trout densities in the UCFR above Deer Lodge is the remediation and restoration of the UCFR. Along with removing tailings material, remediation also removes most of the overhanging vegetation and undercut banks. Overhanging vegetation and undercut banks provide cover for brown trout and other fish species. Remedial efforts aim to put the river on a path to reform these habitat features eventually, but this will likely take years. Habitat simplification may be contributing to the decline in trout numbers in the UCFR, but it is unlikely that habitat simplification is the main driver of the decline. Brown trout are a generalist trout species and tend to do okay in degraded or simplified habitat conditions. FWP has started doing more targeted sampling to understand changes in trout numbers in remediated and unremediated parts of the river. Our data show that declines in brown trout numbers have occurred in both remediated and unremediated reaches of the river. NRDP has allocated funds to further study trout declines and the cause of these declines. Studies will focus on fish production and survival, water quality, and habitat. Results from this effort will be available in the coming years.

Factors such as water quality, disease, environmental conditions other than minimum flows, or a combination of other factors are likely responsible for the decline in trout numbers in the UCFR. Brown trout declines have also recently been reported on the Big Hole, Beaverhead, Ruby, Jefferson, and Madison and other southwest Montana rivers. FWP does not currently understand why brown trout declines are occurring at a regional, or even state-wide scale. FWP conducted a statewide study to investigate factors such as drought, disease, angling pressure, high temperatures and other culprits. None of the variables evaluated in this study were found to be strong predictors of recent brown trout population trends at a statewide or regional scale, but various aspects of flow regimes was a common theme in some rivers (Cline et al. 2022). Additional to regional factors that may be affecting Montana brown trout fisheries, acute metal contamination and remedial habitat simplification are factors that may be affecting brown trout that are also unique to the UCFR.



Map 1. Sections of the Upper Clark Fork River sampled in recent years. Established annual sections are denoted by the yellow stars and sections targeting remediation and restoration by the red X's. The Grant-Kohrs section is within phases 15 and 16.

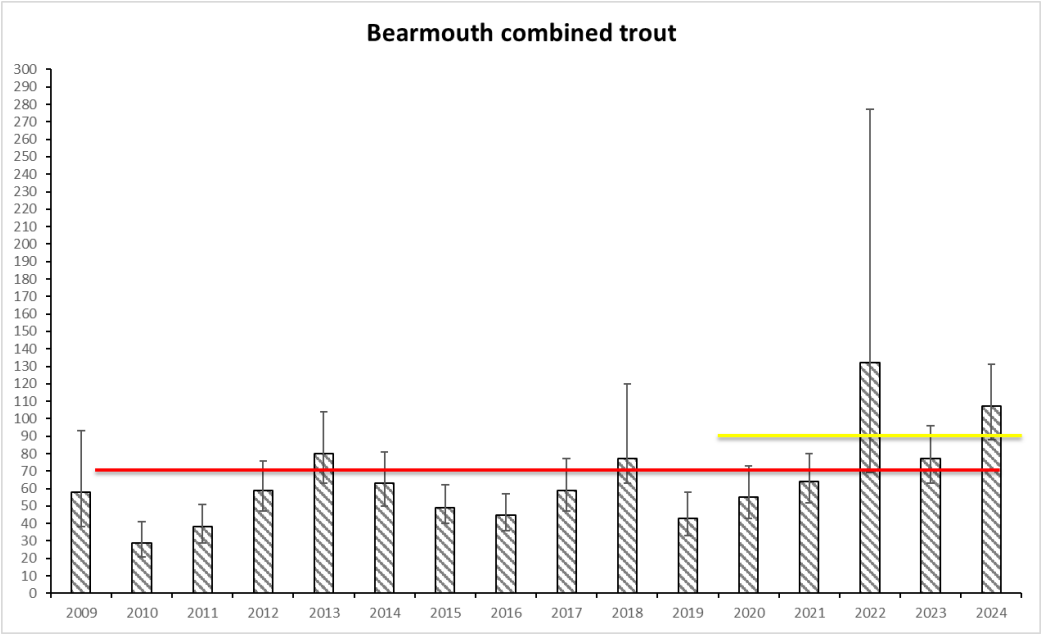


Figure 3. Combined trout estimates for the Bearmouth section. The red line denotes the long-term fish/km average, and the yellow line shows the 5-yeear fish/km average.

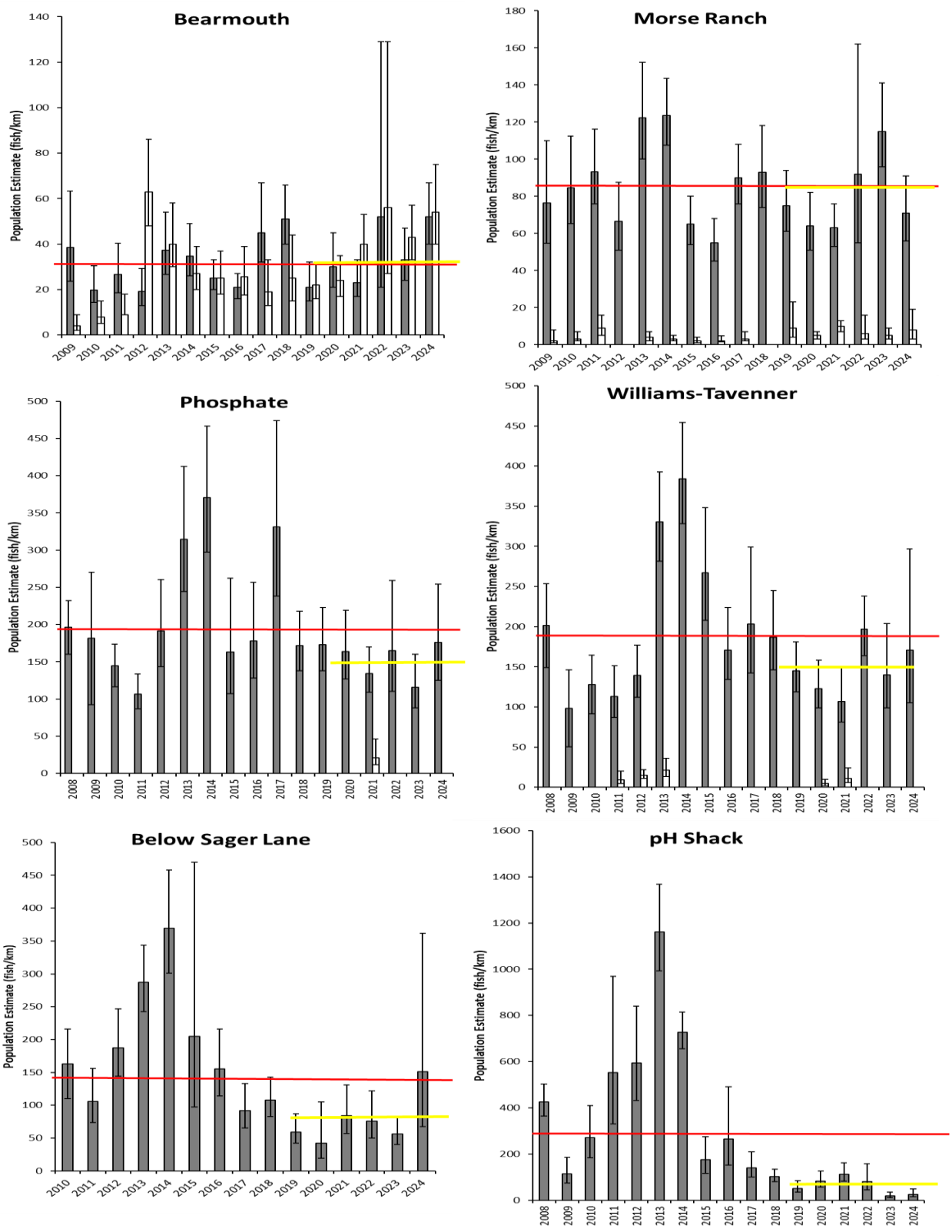


Figure 4. Population estimates for six long-term monitoring sections of the Clark Fork River for fish >175 mm. Grey bars are brown trout estimates and open bars are combined Oncorhynchus estimates. The red line denotes the long-term fish/km average for brown trout and the yellow line shows the 5-year fish/km average for brown trout.

Table 1. Electrofishing data collected in Spring 2024 from annual sampling sections on the Upper Clark Fork River. Population estimates (95% confidence interval) are for trout greater than 175 mm (~ 7") in total length. The WCT estimate at Bearmouth is combined with RBXWCT. The WCT estimate at Morse Ranch is combined with RB. Species abbreviations: LL = Brown Trout, WCT = Westslope Cutthroat Trout, RB = Rainbow Trout, BULL = Bull Trout, RBXWCT = phenotypic hybrid between Rainbow Trout and Westslope Cutthroat Trout, LS SU = Large Scale Sucker, MWF = Mountain Whitefish.

Section	Species	Population Estimate (fish/Km)	# Fish Handled	Mean Length (mm)	Length Range (mm)
Bearmouth	BULL		4	384	384
RM 254-260	LL	52(40-67)	261	341	170-547
	RB	37(25-59)	147	359	184-465
	RBXWCT		27	428	390-467
	WCT	17(11-27)	58	331	184-463
	LS SU		22	388	125-580
	MWF		345	303	150-430
	N PMN		2	410	408-411
Morse Ranch	LL	71(56-91)	376	342	199-549
RM 274-280	RB		9	423	399-450
	RBXWCT		1	340	340
	WCT	8(3-19)	24	323	231-384
Phosphate	LL	176(125-254)	243	287	102-503
RM 287-289	RBXWCT		1	248	248
	WCT		11	323	214-390
Williams Tavenner	EB		1	182	182
RM 306-308	LL	171(105-297)	195	327	114-553
	WCT		3	281	236-350
Kohrs Manning	LL	70(36-149)	83	355	132-580
Diversion to Wastewater Plant	WCT		2	336	325-344
Below Sager Lane	EB		3	244	160-311
RM 315-318	LL	151(67-362)	161	278	119-498
Racetrack Bridge to Huey Long's	LL	38(18-96)	69	304	134-522
pH Shack	EB		2	215	177-253
RM 338-339.5	LL	26(16-49)	345	134	66-550
	MWF		140	227	89-460
	RB		14	143	99-560
	RBXWCT		2	95	89-100
	WCT		1	366	366

CPUE Sites

Catch Per Unit Effort (CPUE) surveys have been conducted at three monitoring sites in the Upper Clark Fork River (Table 2). All sections are approximately one mile long and are done within the long-term monitoring sites at Bearmouth, Phosphate and Below Sager Lane. Two sites (Phosphate and Below Sager Lane) have CPUE data from 2014-2019 while the Bearmouth site has continued to be surveyed yearly. For the CPUE surveys, a portion of the mark/recapture section is surveyed, and all fish species are netted and recorded. This data can be used to determine species composition in the Clark Fork River; however, it should be noted that even though a certain fish species is not captured doesn't mean it isn't present. In Table 2 below, species composition is shown as a percentage of fish captured. A 0% should be interpreted as low abundance or low capture efficiency as opposed to not present. Mountain whitefish are the most captured fish in all three sections. Brown trout are the most captured trout in all three sections.

Table 2. Percentage of fish captured at three CPUE sections on the Upper Clark Fork River. These sections are long-term mark/recapture estimate sections. All fish species are netted in a portion of each section to determine species composition.

Section	Species	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Average
Bearmouth CPUE	BULL	n/a	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	**0%**
	LL	n/a	11%	8%	8%	4%	2%	6%	7%	13%	8%	3%	**7%**
	LN SU	n/a	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	**0%**
	LS SU	n/a	16%	8%	3%	19%	7%	10%	8%	4%	4%	6%	**8%**
	MWF	n/a	63%	83%	84%	74%	85%	80%	72%	70%	78%	88%	**78%**
	N PMN	n/a	1%	0%	1%	1%	0%	0%	1%	0%	0%	1%	**0%**
	RB	n/a	6%	1%	3%	3%	3%	0%	3%	6%	5%	2%	**3%**
	RBXWCT	n/a	0%	0%	0%	0%	1%	3%	2%	0%	0%	0%	**1%**
	RM COT	n/a	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	**0%**
	RS SH	n/a	0%	0%	0%	0%	1%	0%	4%	0%	0%	0%	**1%**
	WCT	n/a	1%	0%	1%	0%	1%	1%	3%	7%	5%	1%	**2%**
Jens CPUE	LL	29%	n/a	17%	20%	19%	19%	n/a	n/a	n/a	n/a	n/a	**21%**
	LN DC	0%	n/a	1%	0%	0%	0%	n/a	n/a	n/a	n/a	n/a	**0%**
	LN SU	0%	n/a	0%	1%	0%	1%	n/a	n/a	n/a	n/a	n/a	**0%**
	LS SU	5%	n/a	4%	3%	10%	2%	n/a	n/a	n/a	n/a	n/a	**4%**
	MWF	64%	n/a	76%	76%	70%	77%	n/a	n/a	n/a	n/a	n/a	**73%**
	RBXWCT	0%	n/a	0%	0%	0%	0%	n/a	n/a	n/a	n/a	n/a	**0%**
	RM COT	0%	n/a	0%	0%	1%	1%	n/a	n/a	n/a	n/a	n/a	**0%**
	RS SH	0%	n/a	0%	0%	0%	0%	n/a	n/a	n/a	n/a	n/a	**0%**
	WCT	0%	n/a	1%	2%	1%	1%	n/a	n/a	n/a	n/a	n/a	**1%**
Above Deer Lodge CPUE	EB	0%	n/a	0%	0%	0%	0%	n/a	n/a	n/a	n/a	n/a	**0%**
	LL	14%	n/a	5%	13%	16%	14%	n/a	n/a	n/a	n/a	n/a	**13%**
	LN DC	0%	n/a	0%	0%	0%	1%	n/a	n/a	n/a	n/a	n/a	**0%**
	LN SU	0%	n/a	0%	0%	0%	0%	n/a	n/a	n/a	n/a	n/a	**0%**
	LS SU	15%	n/a	40%	34%	32%	39%	n/a	n/a	n/a	n/a	n/a	**32%**
	MWF	70%	n/a	55%	52%	52%	46%	n/a	n/a	n/a	n/a	n/a	**55%**

Warm Springs Creek

We conducted population surveys at six sites on Warm Springs Creek in 2024. Three mark and recapture estimate sections, for fish greater than 150 mm (Table 3), using a barge mounted electrofisher and three depletion estimate sites for fish greater than 75 mm (Table 4), using two backpack electrofishers. Surveys on Warm Springs Creek are currently on a three-year cycle and were last completed in 2021 (Figure 5).

Mark and recapture sections

The lowest site at the Warm Springs Wildlife Management Area (WMA) had a brown trout estimate of 416(368-479) fish/km which is down from 500(436-583) in 2021. We were also able to produce a mountain whitefish estimate of 346(282-436) fish/km. The brown trout estimate for the Below Meyers Dam section was 638(607-677) fish/km, up from 577(522-647) in 2021. It is also the highest estimate since 2015. The bull trout estimate was 13(8-32) fish/km, we were not able to get an estimate in 2021. The brook trout estimate was 10(8-20) fish/km, we were not able to get an estimate in 2021. The westslope cutthroat trout estimate was 97(87-115) fish/km, compared to 99(81-122) in 2021. At the Garrity Game Check section the brown trout estimate was 120(104-147) fish/km, up from 57(46-78) in 2021. The bull trout estimate was 23(19-35) fish/km, down from 49(34-83) in 2021. The westslope cutthroat estimate was 224(210-244) fish/km, down from 258(233-294) in 2021.

Depletion sections

The Above Veronica Trail section had a westslope cutthroat trout estimate 17(15-19) fish/100 m, up from 15(14-16) in 2021. The brook trout estimate was 8(5-11) fish/100 m, down from 13(12-14) in 2021. We were not able to produce a bull trout estimate in 2024 after an estimate of 15(11-19) in 2021. The bull trout estimate at the Upper Bridge site was 12(11-13) fish/km. We have been unable to produce a bull trout estimate at this site since 2015. The brook trout estimate was 11(10-12) fish/100 m, we were unable to produce an estimate in 2021. We have not been able to produce westslope cutthroat trout estimates at this site the last two times it was sampled. Below the confluence of the upper forks, the westslope cutthroat trout estimate was 25(19-31) fish/100 m, we were unable to produce an estimate in 2021.

West Fork Warm Springs Creek

One section was surveyed on West Fork Warm Springs Creek in 2024 (Table 4). Estimates on this section have been done on the same years as the rest of the Warm Springs Creek sections. The westslope cutthroat trout estimate was 21(19-23) fish/100 m in 2024, compared to 29(25-33) in 2021. This is the lowest estimate since monitoring began at this site in 2010. We were able to get an estimate for bull trout in 2010 but have been unable to since then. Low numbers of bull trout have been captured each year except for 2017 and 2024.

Table 3. Electrofishing data collected during mark and recapture estimates in 2024 at three sites on Warm Springs Creek. Population estimates (95% CI) are for fish greater than 150 mm (~ 6") in total length.

Section Name/RM	Species	Population Estimate (fish/Km)	# Fish Handled	Length Range (mm)	Average Length (mm)
WMA	EB		1	251	251
	LL	416(368-479)	530	100-466	172
	MWF	346(282-436)	205	120-430	248
	RB		1	285	285
	WCT		1	145	145
Below Meyers Dam	BULL	13(8-32)	10	134-683	277
	EB	10(8-20)	10	86-217	178
	EBXBULL		4	510	510
	LL	638(607-677)	881	63-426	206
	MWF		2	175-429	233
	RBXWCT		8	105-445	213
	WCT	97(87-115)	139	50-424	196
Garrity WMA	BULL	23(19-35)	22	57-313	220
	EB		8	125-215	166
	LL	120(104-147)	156	62-380	183
	RB		10	134-317	212
	RBXWCT		8	146-285	183
	WCT	224(210-244)	421	44-405	163

Table 4. Electrofishing data collected during depletion estimates in 2024 at four sites on Warm Springs Creek. Population estimates (95% CI) are for fish greater than 75 mm (~ 3") in total length.

Section Name/RM	**Species**	**Estimate per 100m**	**# Fish Handled**	**Length Range (mm)**	**Average Length (mm)**
Veronica Trail	BULL		5	66-219	160
	EB	8(5-11)	11	66-166	123
	EBXBULL		1	137	137
	LL		2	197-207	202
	RBXWCT		1	187	187
	WCT	17(15-19)	18	69-348	143
Upper Bridge	BULL	12(11-13)	12	185-267	226
	EB	11(10-12)	11	141-241	191
	WCT		5	143-218	170
Below Upper Forks	EB		1	195	195
	WCT	25(19-31)	24	73-191	133
West Fork WS Below upper road crossing RM 6.3	WCT	21(19-23)	40	43-170	91

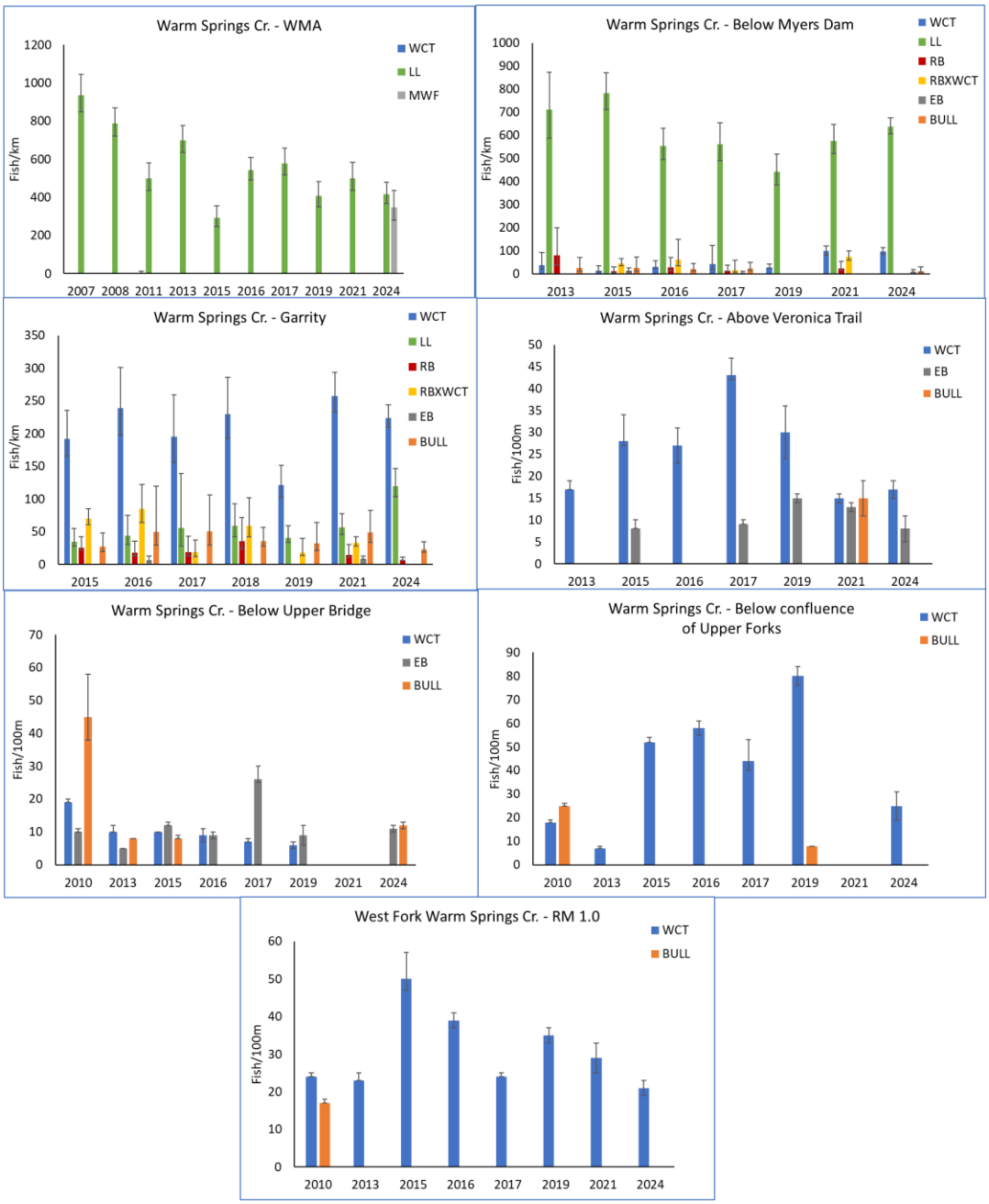


Figure 5. Population estimates for six sections on Warm Springs Creek and one section on West Fork Warm Springs Creek in 2024.

Barker Creek

Two sections were surveyed on Barker Creek in 2024 (Table 5). Estimates have been completed on Barker Creek on the lower section since 2015 and the upper section since 2010 (Figure 6). Bull trout are the most abundant fish species in both sections. The bull trout estimate on the lower section was 23(17-30) fish/100 m, down from 33(28-38) in 2021. The westslope cutthroat trout estimate was 5(4-6) fish/100 m which is the same as 2021. The bull trout estimate for the upper section was 43(36-49) fish/100 m, which

is like the 2021 estimate of 44(34-55). The westslope cutthroat trout estimate was 12(11-13) fish/100 m, up from 5(4-6) in 2021.

Table 5. Data collected for Barker Creek in 2024. Population estimates (95% CI) are for trout greater than 75 mm (~ 3") in total length.

Section Name/RM	Species	Estimate per 100m	# Fish Handled	Length Range (mm)	Average Length (mm)
Lower RM 0.5	BULL	23(17-30)	25	44-193	134
	WCT	5(4-6)	5	75-205	147
Upper RM 1.5	BULL	43(36-49)	55	79-242	125
	WCT	12(11-13)	18	69-258	164

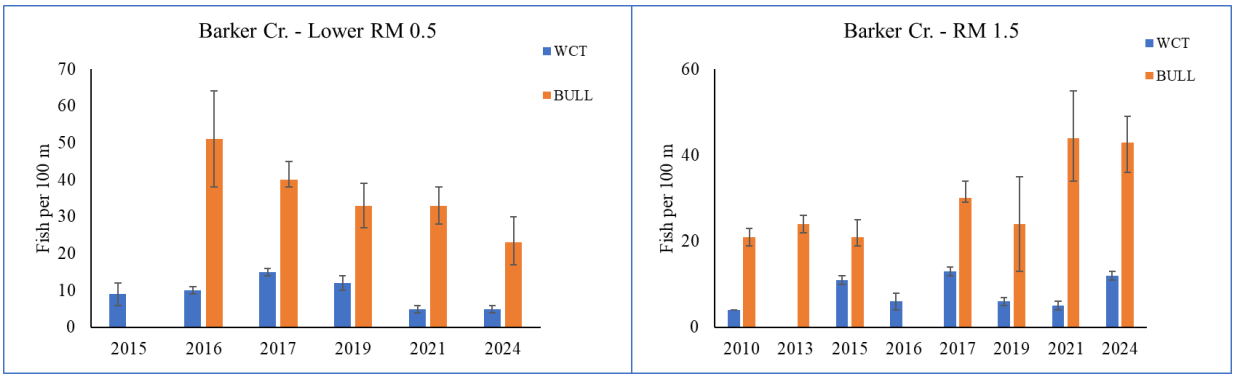


Figure 6. Population estimates for two sections on Barker Creek in 2024.

Foster Creek

Three sections were surveyed on Foster Creek in 2024 (Table 6). Estimates have been completed on all three sections since 2015 (Figure 7). Westslope cutthroat trout are the most abundant fish in all three sections. The westslope cutthroat estimate for the lower sections was 128(122-134) fish/100 m, up from 98(86-110) in 2021. This is the highest estimate in the lower section since surveys started in 2015. Bull trout and brook trout were captured as well but an estimate could not be produced. The westslope cutthroat estimate for the middle section was 37(35-39) fish/100 m, up from 27(21-33) in 2021. Brook trout were also captured in the section, but an estimate could not be produced. The westslope cutthroat estimate for the upper section was 43(40-46). This estimate has been stable since 2019. Brook trout were also capture in the upper section but and estimate could not be produced.

Table 6. Electrofishing data collected from Foster Creek in 2024. Population estimates (95% CI) are for trout greater than 75 mm (~ 3") in total length.

Section Name/RM	Species	Estimate per 100m	# Fish Handled	Length Range (mm)	Average Length (mm)
Lower RM 1.0	BULL		1	179	179
	EB		12	49-188	109
	WCT	128(122-134)	127	68-237	118
Middle RM 2.3	EB		4	114-127	120
	EBXBULL		1	133	133
	WCT	37(35-39)	40	46-197	95
Upper RM 3.8	EB		1	143	143
	WCT	43(40-46)	59	45-196	109

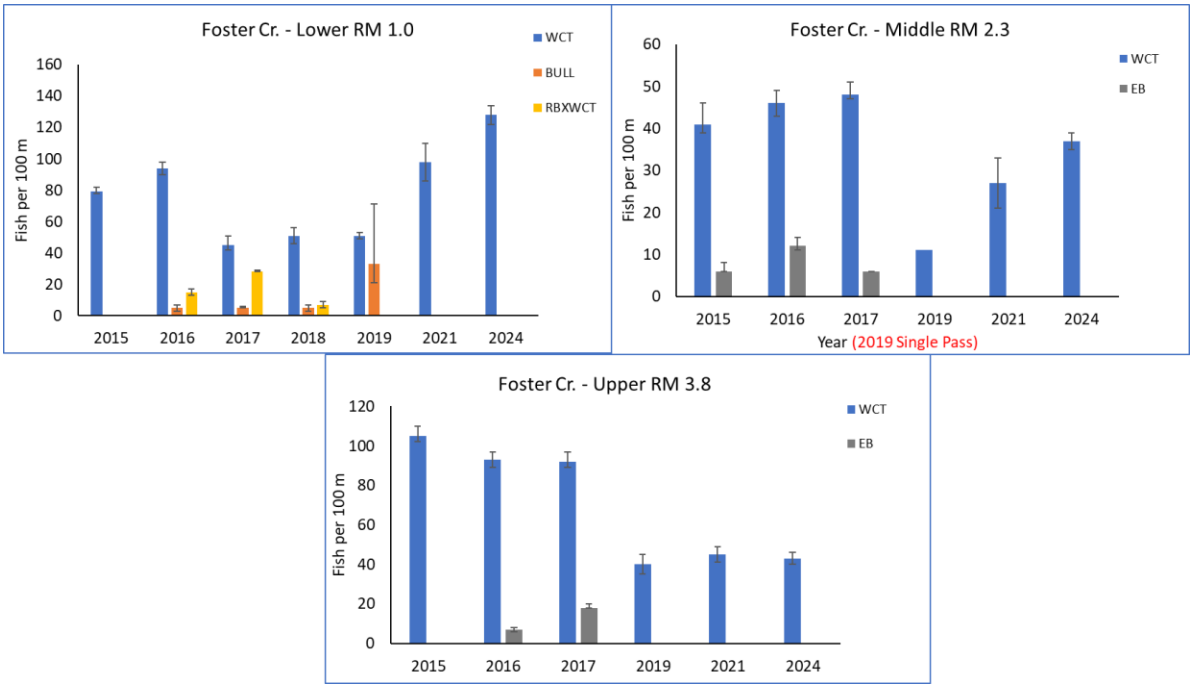


Figure 7. Population estimates for three sections on Foster Creek in 2024.

Twin Lakes Creek

Population estimates were conducted at three sites on Twin Lakes Creek in 2024 (Table 7). Estimates have been completed at two sites since 2010 and the other since 2013 (Figure 8). Westslope cutthroat trout were the most abundant fish species in all three sections. The westslope cutthroat trout estimate for the lower section was 24(18-30) fish/100 m, up from 21(20-22) in 2021 and the highest estimate since 2015. Bull trout, brook trout, rocky mountain and slimy sculpin were also captured in this section. The westslope cutthroat estimate for the meadow section was 38(33-43) fish/100 m, up from 15(14-16) in 2021 and the highest estimate since 2016. The brook trout estimate was 17(15-19) fish/100 m, down from 23(22-24) in 2021. Rocky mountain and slimy sculpin were also captured in this section. The westslope cutthroat estimate for the upstream of old bridge section was 15(14-16) fish/100 m, down from 18(16-20) in 2021 and the lowest estimate since monitoring began in 2010. The brook trout estimate was 6(6-6) fish/100 m. This is the first time a brook trout estimate could be produced since 2015. Rocky mountain and slimy sculpin were also captured in this section.

Table 7. Electrofishing data collected from Twin Lakes Creek in 2024. Population estimates (CI 95%) are for fish >75 mm (~3") in total length. Only a single pass survey was conducted at RM 7.2.

Section Name/RM	Species	Estimate per 100m	# Fish Handled	Length Range (mm)	Average Length (mm)
Lower RM 1.3	BULL		1	181	181
	EB		3	139-217	174
	EBXBULL		1	194	194
	RM COT		2	118-128	123
	SL COT		1	120	120
	WCT	24(18-30)	21	75-212	144
Meadow RM 2.8	EB	17(15-19)	20	39-289	131
	RM COT		5	84-115	98
	SL COT		3	79-117	104
	WCT	38(33-43)	37	71-270	133
Upstream of old bridge RM 4.6	COT		1	70	70
	EB	6(6-6)	7	50-172	125
	RM COT		6	73-127	109
	SL COT		3	74-129	106
	WCT	15(14-16)	18	63-222	130

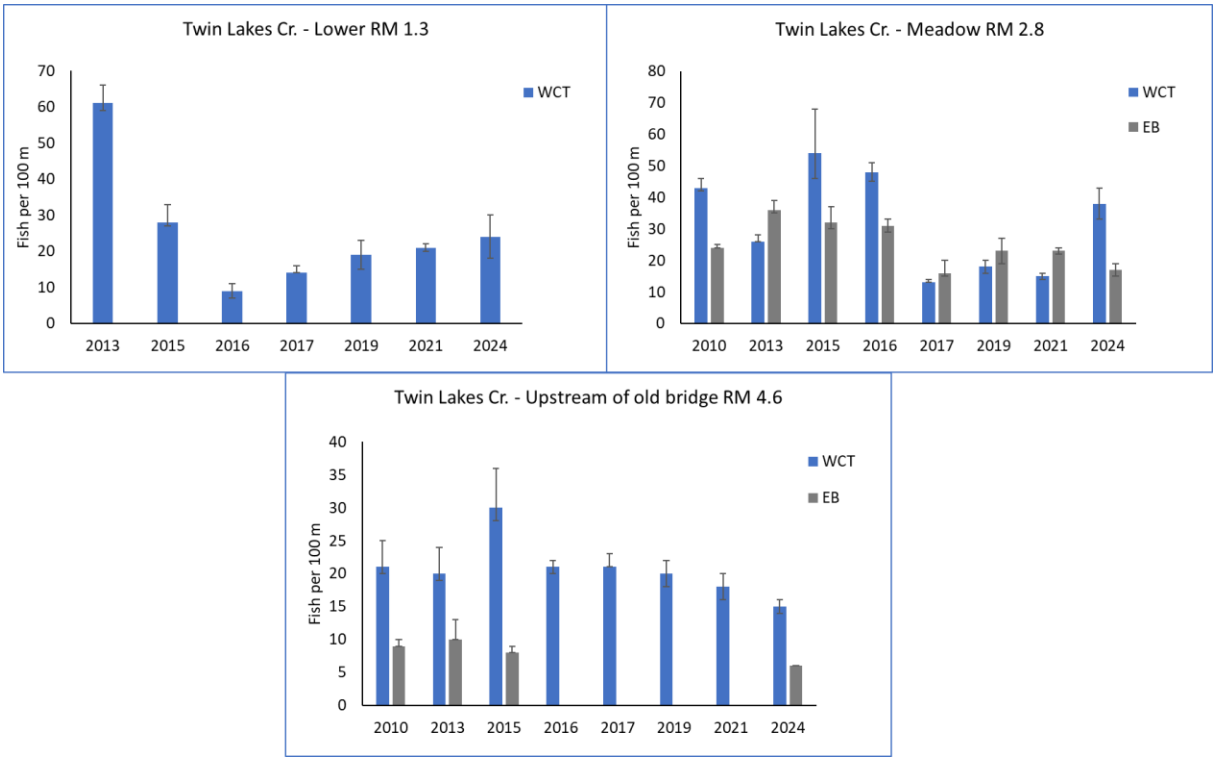


Figure 8. Population estimates for three sections on Twin Lakes Creek in 2024.

Storm Lake Creek

Population estimates were conducted at four sites on Storm Lake Creek in 2024 (Table 8). Estimates have been completed at all four sites since 2010 (Figure 9). Brook trout were the most abundant fish species in the lower two sections while westslope cutthroat trout were the most abundant fish species in the upper two sections. The brook trout estimate in the lower section was 12(9-15) fish/100 m, down form 14(13-15) in 2021. Bull trout and westslope cutthroat trout were also captured in this section but estimates could not be produced. Estimates of three species were possible at the above first road crossing section. The bull trout estimate was 17(15-19) fish/ 100 m, up from 10(8-12) in 2019, no estimate was produced in 2021. The brook trout estimate was 34(14-54) fish/100 m, up from 20(16-24) in 2021. The westslope cutthroat trout estimate was 22(20-24) fish/100 m, up from 12(11-13) in 2021. Brook trout X bull trout hybrids were also captured in this section. The westslope cutthroat estimate in the lower end of meadow section was 32(27-37) fish/100 m, up from 10(9-11) in 2021. Bull trout, brook trout and brook trout X bull trout hybrids were also captured in this section. The westslope cutthroat estimate in the below upper road crossing section was 38(33-43) fish/100 m, up from 17(16-18) in 2021. Bull trout and brook trout X bull trout hybrids were also captured in this section.

Table 8. Electrofishing data collected from Storm Lake Creek in 2024. Population estimates (CI 95%) are for fish >75 mm (~3") in total length.

Section Name/RM	Species	Estimate per 100m	# Fish Handled	Length Range (mm)	Average Length (mm)
Lower RM 0.6	BULL		7	76-109	90
	EB	12(9-15)	17	87-181	117
	WCT		2	87-170	129
Above first road crossing RM 1.4	BULL	17(15-19)	17	82-555	122
	EB	34(14-54)	26	94-183	133
	EBXBULL		6	117-172	140
	WCT	22(20-24)	23	65-203	136
Lower end of meadow RM 4.2	BULL		4	38-215	159
	EB		4	107-189	140
	EBXBULL		2	144-214	179
	WCT	32(27-37)	40	44-220	97
Below upper road crossing RM 6.3	BULL		3	172-220	199
	EBXBULL		2	1440-233	187
	WCT	38(33-43)	61	54-189	86

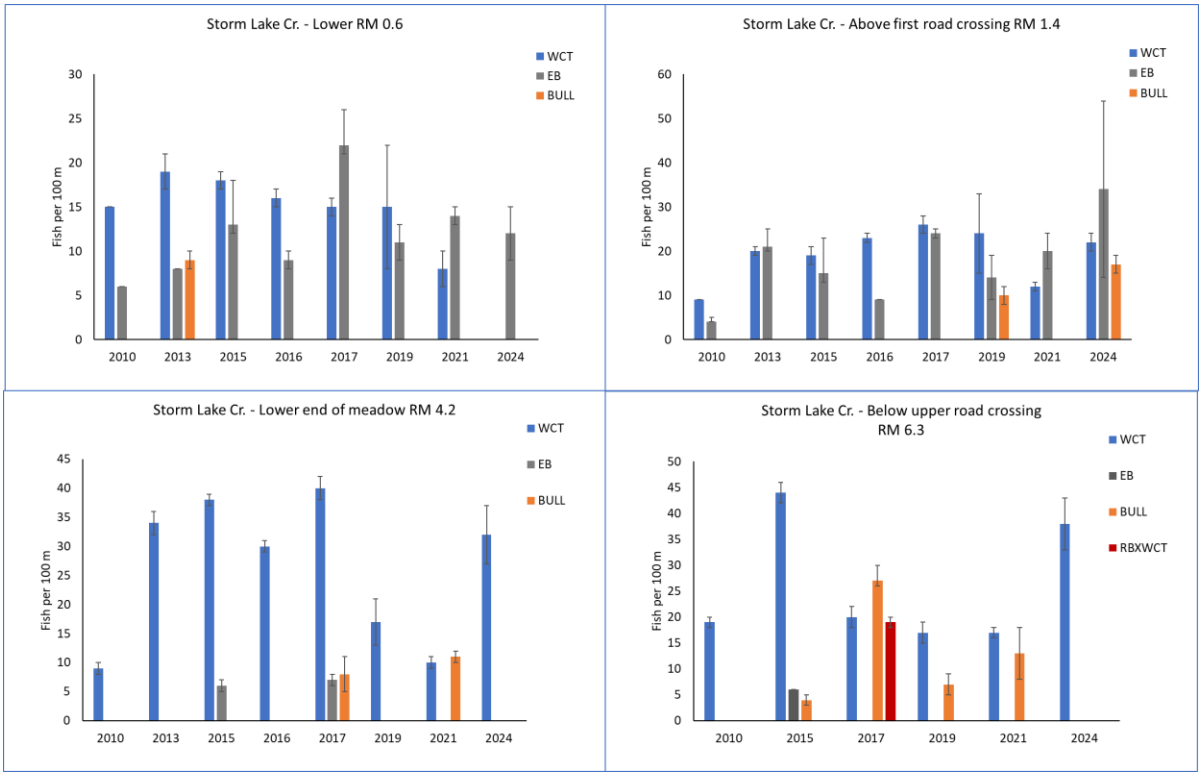


Figure 9. Population estimates for four sections on Storm Lake Creek in 2024.

Silver Bow Creek

Sampling strategy

Fisheries monitoring in Silver Bow Creek began in earnest when the first fish (suckers and sculpins) were documented near Rocker in 2002. As fish populations expanded in response to remediation, fish monitoring efforts also expanded. Over the years, most fish surveys have occurred during the fall. However, spring surveys were conducted at the Father Sheehan Section in 2005 and 2007-2014 and in the summer of 2015. Both spring and fall surveys were conducted at multiple sections in 2014 and 2015. Spring sampling was moved to summer starting in 2016. Summer sampling was done to document fish numbers and distribution during the period of warm water temperatures. The fall sampling was designed to represent a period when high water temperatures were no longer limiting to trout. Since 2015, sampling was conducted using two backpack electrofishers. From 2015-2018, we attempted to get population estimates (Zippin 1958) in both summer and fall, but this proved difficult in some sections due to low fish densities and deep water. Instead, we report counts of fish captured, standardized by electrofishing time (referred to as Catch Per Unit of Effort or CPUE). CPUE during fall through time can be found in Table 6. Starting in 2019, fish sampling was further complicated by an increase in discharge and water conductivity caused by releases of treated mine water in Butte. The high conductivity is due to the addition of lime during the treatment process and this increase was significant enough to reduce the efficacy of using electrofishing to capture fish. Thus, fish capture data from 2019 on may not be directly comparable to previous years for sections downstream of Butte. To increase capture efficiency in 2020, a generator-powered, barge-mounted electrofishing unit was used on the German Gulch and Fairmont sections instead of backpack electrofishers. These two sections have especially fast water and deep pools that, combined with increased discharge and water conductivity, were very difficult to sample with backpack units.

Sampling summary

Only two sections of Silver Bow Creek were sampled in 2024 (Table 9). Single pass backpack electrofishing samples were conducted at the Ramsay and LAO sections. Both sections have been surveyed annually in the fall since 2013 (Figure 10).

Ramsay Section

Suckers and sculpin were first found in the Ramsay section in 2005, and trout were first captured in fall 2007. Summer sampling at Ramsay was started in 2016. The Ramsay section was characterized by moderately high trout densities during the fall and low densities during the summer through 2020. One brown trout was captured in the Ramsay section in fall of 2016, which is the only documented occurrence of brown trout in the Silver Bow basin upstream of a barrier near Fairmont constructed in 2017. The increase in discharge and water conductivity following the discharge of treated Berkeley Pit water began in 2019 brings into question whether electrofishing efficiency is affecting fish capture rates. Although the Ramsay section has held relatively high numbers of westslope cutthroat trout in the past during the fall, westslope cutthroat CPUE was down dramatically in fall of 2020 and no westslope cutthroat were captured in the section in 2021. This trend continued in 2022 and no westslope cutthroat were captured in the Ramsay section. Capture rates for brook trout and longnose suckers increased in

2022 so it appears that electrofishing efficiency may not be to blame for the lack of westslope cutthroat captures. More fish and fish species were captured in 2023 and the first westslope cutthroat was captured since 2020. Brook trout, Rocky Mountain sculpin and long nose sucker numbers have increased over the last several years while native westslope cutthroat trout have been nearly absent. Brook trout numbers in 2023 were the highest ever since sampling started in 2013 and nearly 10 times as many fish were captured compared to 2022. Many of the same trends continued in 2024. No westslope cutthroat trout were captured and brook trout numbers remained higher than the long-term average. Rocky Mountain scuplin are still the most abundant species while long-nose sucker numbers were lower than the past several years (Figure 9).

LAO Section

Longnose suckers, sculpin, and central mudminnow were captured during the first survey of the LAO section in 2005. Brook trout were first captured at LAO in 2007 and westslope cutthroat trout in 2009. Brook trout tend to outnumber westslope cutthroat in this section. Trout catch rates are higher during the fall sampling compared to summer sampling, suggesting trout move in and out of this part of Silver Bow Creek as conditions change with the seasons. Catch rates of brook trout, westslope cutthroat, longnose suckers, and rocky mountain sculpin in the fall of 2022 were within range of previous years' surveys. The number of fish captured in the LAO section decreased from 2022 to 2023 but are still within the range of previous years' surveys. The number of brook trout captured in 2024 was the highest number since regular sampling began in 2013. Westslope cutthroat captures remained low while Rocky Mountain sculpin captures were near triple past surveys and continue to be the most abundant species (Figure 9).

Table 9. Electrofishing data collected in Fall 2024 from two sampling sections on Silver Bow Creek. Single pass backpack electrofisher CPUE and species composition. Species abbreviations: WCT = Westslope Cutthroat Trout, EB = Eastern Brook Trout, RBXWCT = phenotypic hybrid between Rainbow Trout and Westslope Cutthroat Trout, LN SU = Longnose Sucker, RM COT = Rocky Mountain Sculpin, CM MN = Central Mudminnow.

Section	Species	# Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
Ramsay	CM MN	3	92	84-100	1
RM 20.5	EB	40	138	87-323	20
	LN SU	5	78	64-92	3
	RM COT	150	82	49-115	76
LAO	EB	14	153	100-246	8
RM 27.4	RBXWCT	1	284	284	<1
	RM COT	155	88	44-131	91
	WCT	1	357	357	<1

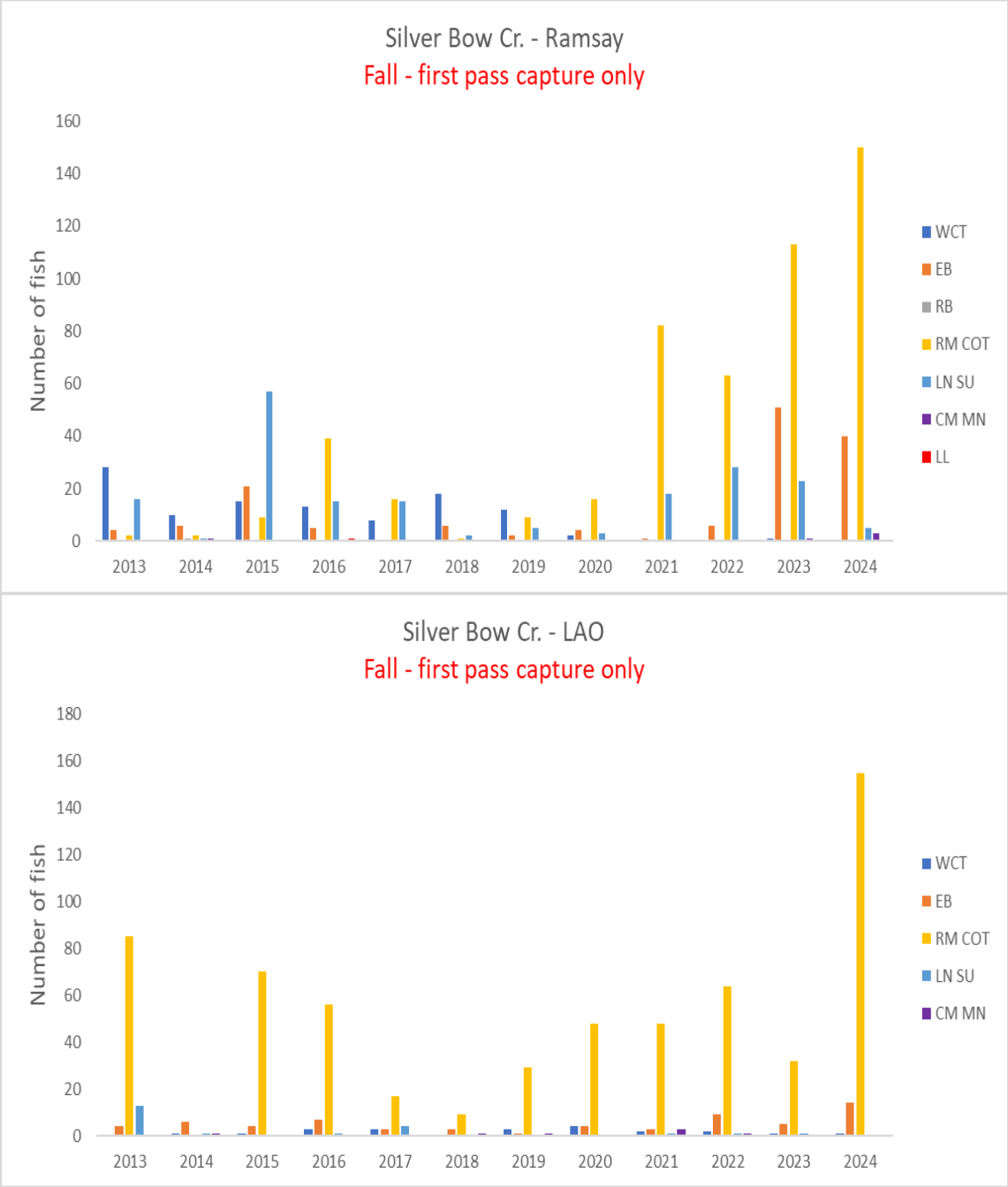


Figure 10. Fall single pass fish captures at two sites on Silver Bow Creek.

Discussion

Prior to the start of remedial actions in 1999, Silver Bow Creek was considered fishless. Suckers and sculpin first recolonized Silver Bow Creek followed by brook trout and westslope cutthroat trout. Tributaries were less impacted by mine waste and metals contamination and have served as a source of fish recruitment to mainstem Silver Bow Creek. German Gulch is a critical spawning stream for

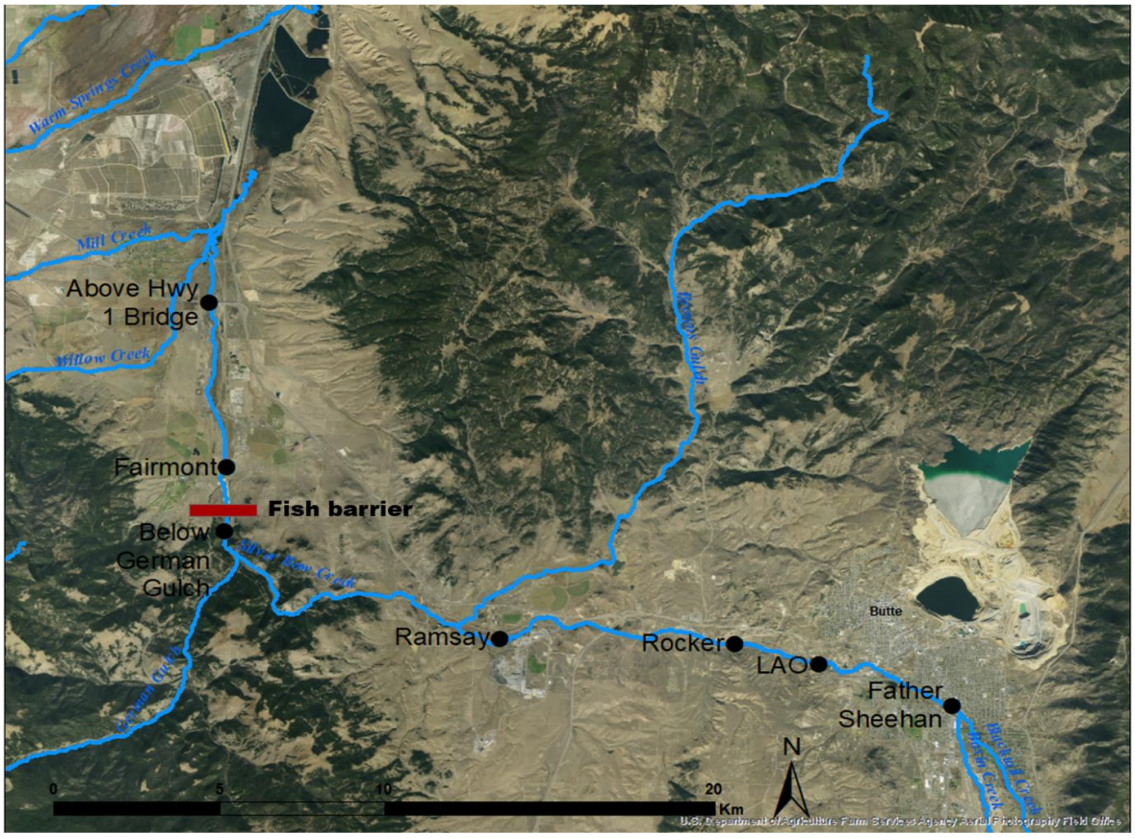
westslope cutthroat and brook trout. Given the high numbers of brook trout in the Father Sheehan section, it is likely that Blacktail Creek is a source of trout to the upper reaches of Silver Bow Creek. Blacktail Creek is also a likely source of westslope cutthroat trout, which are common in the upper reaches of the tributary. A recent radio telemetry study showed westslope cutthroat trout using upper Blacktail Creek and tributaries for spawning. Compared to Father Sheehan, the LAO section holds far fewer trout, even though it is only about 3 miles downstream. At the Rocker section, which is about 2 miles downstream of LAO, trout are even less abundant. Cleanup of metals contamination has allowed fish to become established throughout Silver Bow Creek and enabled the establishment of substantial trout populations in certain parts of the creek (i.e., immediately downstream of German Gulch). However, habitat and water quality (i.e. temperature and dissolved oxygen) conditions in much of Silver Bow Creek within and immediately downstream of Butte are likely limiting factors for trout populations.

The Silver Bow Creek trout fishery is characterized by fish that concentrate near the mouths of German Gulch and Blacktail Creek. Westslope cutthroat trout especially concentrate in Silver Bow Creek near German Gulch in the summer because this tributary is a primary source of cold water. Westslope disperse away from German Gulch into areas such as Ramsay as water cools off during the fall. In the past, areas of Silver Bow Creek downstream of Butte have had low dissolved oxygen during hot summer nights (Naughton 2013), although DO conditions appear to have improved since the Butte wastewater treatment plant was improved in 2015 and 2016 (Nagisetty et al. 2019). However, nighttime DO concentrations are still dipping below water quality standards for typical trout bearing streams (i.e., 8 mg/L for class B streams: MT DEQ 2017). Limiting conditions in mainstem Silver Bow Creek should be investigated and eventually addressed to maximize the benefits of tributary restoration efforts on the mainstem fishery.

At the Ramsay section, fall catch rates of westslope cutthroat trout and brook trout in 2020 and 2021 were well below average. No westslope cutthroat were captured in 2021, which was the first fall sampling at Ramsay without westslope cutthroat since 2007. This trend continued in 2022 with no westslope cutthroat being captured. One westslope cutthroat was captured in 2023. Brook trout numbers have also normally been low with an average of six brook trout per section from 2013-2022. We captured 51 brook trout in 2023. The previous high was 21 brook trout in 2015. This section has had high westslope cutthroat numbers during previous fall sampling periods, with an average of 15 per section from 2013-2019. It is unclear if reduced electrofishing efficiency due to a 2-3X increase in specific conductivity is responsible for the reduction in CPUE. It is also possible that trout are avoiding this part of Silver Bow Creek due to changes in water chemistry. During baseflow conditions, flows in this part of Sliver Bow Creek have been up to 50% treated water, much of which is treated Berkley Pit water. The effects of the Berkley Pit effluent, as well as effluent from municipal wastewater treatment should be thoroughly investigated.

Migratory fish, especially westslope cutthroat trout, provide a significant portion of the overall trout fishery in Silver Bow Creek. The importance of German Gulch as a source of migratory fish has been well established by tagging studies and population sampling. However, contributions of migratory individuals from other tributaries are not as well understood. As restoration efforts progress on Brown's Gulch, Basin Creek, and Blacktail Creek, monitoring could be conducted to determine the prevalence of migratory fish from these tributaries and identify remaining impediments to fish passage. Preliminary

results from a telemetry study conducted by FWP that began in 2023 showed migratory westslope cutthroat from Silver Bow Creek migrating to the upper reaches of the Blacktail Creek drainage to spawn. One individual also went into Browns Gulch during the spawning timeframe, but a spawning location was not documented. Further work is likely necessary to document how prevalent spawning activity in these two tributaries is, and how successful juveniles are at out-migrating from them. Blacktail Creek has several potential infrastructure barriers located between documented spawning locations and Silver Bow Creek. Flows during the spring of 2023 were generally high in Blacktail Creek, these barriers may not be navigable for fish during all flow years. Recruitment from all connected tributaries to Silver Bow Creek is important to long term health of the populations in the basin. However, until limiting factors (i.e., dissolved oxygen and temperature) in Silver Bow Creek are addressed the fluvial population and connectivity between populations will remain limited.



Map 2. Map of seven annual fish sampling sections on Silver Bow Creek.

Cottonwood Creek Fish Screen PIT Study

Diversion upgrade and screening effort evaluation

Cottonwood Creek has been evaluated to be an important tributary for maintaining and improving westslope cutthroat trout population in the mainstem upper Clark Fork River. Chronic dewatering and connectivity within the drainage and to the Clark Fork River are key issues to address for optimizing westslope cutthroat trout recruitment from Cottonwood Creek. Many of the irrigation structures known to be an impediment to migrating westslope cutthroat trout in Cottonwood Creek have been addressed over the past few years. However, several irrigation structures that are likely key to overall success in the drainage remain impediments for migrating fish.

To assess the success of completed projects and identify future projects that are key to overall success in the drainage, FWP continued a passive integrated transponder (PIT) tag study in the drainage that began in summer 2022. PIT antennas were placed at four locations on Cottonwood Creek. The most upstream site on Cottonwood Creek was at the recently rebuilt and screened McQueary Diversion at RM 5.8 (Map 1). This location is at the lower end of the cutthroat stronghold in Cottonwood Creek and what is believed to be the likely spawning habitat for fish migrating from the river. The reader was set up to read fish migrating in the stream or being bypassed by the screen. The next reader was placed at the recently rebuilt and screened Applegate diversion located at RM 3.0 in Cottonwood Creek (Map 2). This diversion also marks the upstream extent of a large section of Cottonwood Creek that is dewatered for much of the year due to irrigation and natural sub-surface flows. This reader was set up to evaluate fish migrating past this point in the stream and being bypassed by the screen. The final two readers were placed in Cottonwood Creek at its confluence with the Clark Fork River. One reader was placed just upstream of the point where the Kohrs-Manning Ditch intersects Cottonwood Creek, the final reader was placed about 10m downstream just below where the ditch intersects the creek (Map 3). These two readers are intended to assess the impact of the Kohrs-Manning ditch and its diversion on Cottonwood Creek to fish migrating to and from the Clark Fork River. We hypothesize that this ditch crossing, and diversion structure represent a barrier to fish migrating up and downstream throughout much of, or all year and may be critical to address to realize benefits of upstream projects to the Clark Fork River.

Map 1. Location of PIT antennae on the McQueary diversion bypass pipe and Cottonwood Creek upstream of the bypass pipe.

Map 2. Location of PIT antennae on Cottonwood Creek and Applegate diversion bypass pipe.

Map 3. Location of PIT antennae near the mouth of Cottonwood Creek.

Fish Tagging

Fish were PIT tagged at several locations throughout the Cottonwood Creek drainage in 2023. All PIT tagging occurred upstream of the McQueary diversion in Cottonwood Creek and was expanded into several tributaries. Expanding from the 2022 tagging, fish were tagged in North Fork, Middle Fork and South Fork Cottonwood Creek and Baggs Creek (Table 10). A total of 341 westslope cutthroat trout were tagged in 2023. In 2024, 71 brown trout were tagged upstream of the Grant Kohrs Ranch (Table 11). Between 2022 and 2024, a total of 655 fish have been tagged in the Cottonwood Creek drainage (Table 12).

Table 10. Total number of westslope cutthroat trout PIT tagged in the Cottonwood Creek drainage in 2023.

	Tagging Location					
Speices	**Cottonwood Above McQueary RM 6.8**	**Middle Fork Cottonwood RM 0.7**	**North Fork Cottonwood RM 0.3**	**South Fork Cottonwood RM 1.3**	**Baggs Creek RM 2.4**	**Total**
westslope cutthroat trout	138	111	21	30	41	**341**

Table 11. Total number of fish tagged in 2024.

	Tagging Location
Species	**Upstream of Grant Kohrs Ranch**
brown trout	71

Table 12. Total number of fish tagged in the Cottonwood Creek drainage in from 2022-2024.

Species	Total # Tagged
brown trout	150
westslope cutthroat trout	505
Total	**655**

Results

At the upper most PIT station on the McQueary diversion there were five fish detected on the antennas. All five fish were detected on the antenna in Cottonwood Creek and two of those five fish were detected on the bypass pipe antenna. All fish detected on these antennas were westslope cutthroat trout tagged in the vicinity of the McQueary diversion.
At the next PIT station downstream at the Applegate diversion near RM 3.0 on Cottonwood Creek, one fish was detected on the antenna in Cottonwood Creek. The fish detected was a westslope cutthroat trout which was tagged in 2022 upstream of the McQueary fish screen.
At the lowest PIT stations, 28 fish were detected at the antenna upstream of the Kohrs-Manning ditch and five fish were detected at the antenna below the diversion. Twenty-six of the fish detected at the antenna upstream of the Kohrs-Manning ditch were brown trout and two were westslope cutthroat trout. All the brown trout detected were tagged just upstream of the antenna site. One of the westslope cutthroat detected was tagged upstream of the McQueary ditch in 2022 and the other was tagged in the Clark Fork River near Cottonwood Creek in 2024. Of the fish detected at the mouth antenna, three were brown trout and two were westslopet cutthroat trout. The three brown trout were also detected on the antenna upstream of the Kohrs-Manning ditch and were all determined to be moving downstream into the Clark Fork River and were all tagged in 2024 just upstream of the Grant Kohrs Ranch. The westslope tagged upstream of the McQueary ditch is the same fish that was detected at the antenna upstream of the Kohrs-Manning ditch and at the Applegate antenna. The other westslope was not detected on any other antennas in Cottonwood Creek.

Discussion

From past studies (Mayfield 2013) we know that westslope cutthroat trout enter Cottonwood Creek in the spring from the Clark Fork River to spawn. 2024 was the first time in our current PIT tag study that westslopes have been documented entering or attempting to enter Cottonwood Creek. Two westslope cutthroat trout that were tagged in the Clark Fork River in April of 2024 were detected on the lower two antennas. One of those fish entered the mouth of Cottonwood Creek below the diversion and was detected on May 11th and May 13th. Since it was not detected on any other antennas after that, it was unable to pass over the diversion structure or chose to go elsewhere. The other westslope from the river was not detected on the mouth antenna but was detected on the antenna upstream of the Kohrs-Manning ditch on May 13th. It is possible that this fish entered the Kohrs-Manning ditch upstream of Cottonwood Creek instead of passing over the diversion. This fish was not detected on any other antennas, so its fate is unknown. However, a section of Cottonwood Creek downstream of the Applegate Diversion was already dry at this time and it is unlikely this fish would have been able to get beyond that point during the spawning season in 2024. One westslope cutthroat trout that was tagged

upstream of the McQueary ditch in 2022 was detected at the mouth antenna on April 28th. It was subsequently detected on the antenna upstream of the Kohrs-Manning ditch on April 29th, May 10th and 31st, and June 1st,2nd and 3rd before being detected at the Applegate diversion on June 6th. It was not detected on any other antennas after that.

Spotted Dog Creek

Four sections were sampled on Spotted Dog Creek in 2024 (Table 13). The lower two sections are in two areas of restoration work and have been sampled annually since 2020 to monitor fish response to restoration efforts. The upper two sites have been monitored consistently since 2018 and are being used as controls for the restoration reaches (Figure 11). The brook trout estimate was 60(50-70) fish/100 m and the westslope cutthroat trout estimate was 39(35-43) fish/100 m at the Restoration Phase 2 site. The brook trout estimate was 115(111-119) fish/100 m and the westslope estimate was 25(25-25) fish/100 m at the Upper BDA site. No other species were captured in the lowest section. Longnose suckers were captured at the Upper BDA site. At the Below Forest Service site, the brook trout estimate was 51(50-52) fish/100 m and the westslope estimate was 51(48-54) fish/ 100 m. The upper most site above the North Fork confluence had a brook trout estimate of 10(9-11) fish/100 m and a westslope estimate of 19(18-20) fish/100 m. Slimy sculpins were also present at both upper sites. Brook trout estimates in 2024 were like 2023 estimates at all four sites. Westslope cutthroat trout estimates in 2024 were like 2023 estimates at three of the four sites. The estimate at the Above North Fork Spotted Dog Creek Confluence site was about half of the 2023 estimate and the lowest estimate since sampling started in 2014.

Table 13. Electrofishing data collected on Spotted Dog Creek in 2024. Population estimates (95% CI) are for trout greater than 75 mm (~ 3") in total length. Species abbreviations: WCT = Westslope cutthroat trout, EB = Eastern Brook trout, LN SU = Longnose sucker, SL COT = Columbia Slimy Sculpin.

Section	Species	Population Estimate (Fish/100m)	# Fish Handled	Mean Length (mm)	Length Range (mm)
Restoration Phase 2 RM 8.0	EB	60(50-70)	59	123	43-206
	WCT	39(35-43)	38	138	87-218
Upper BDA RM 8.4	EB	115(111-119)	113	139	87-243
	WCT	25(25-25)	25	157	103-216
Below Forest Service RM 9.8	EB	51(50-52)	51	123	85-205
	WCT	51(48-54)	61	109	59-225
Above North Fork Confluence RM 11.3	EB	10(9-11)	10	119	84-158
	SL COT		1	55	55
	WCT	19(18-20)	38	80	44-155

South Fork Spotted Dog Creek

Sampling on two sections of South Fork Spotted Dog Creek began in 2023 to get pre-restoration data for a Beaver Dam Analog (BDA) project (Table 14). The lower section is the BDA Treatment Reach, and the upper section is the BDA Control Reach (Figure 12). Depletion estimates were conducted for the BDA Control Reach in 2023 and 2024. The brook trout estimate for 2024 was 113(104-122) fish/100 m and the westslope cutthroat trout estimate was 37(32-42) fish/100 m. Both estimates are slightly higher than the 2023 estimates. An estimate was not possible in the BDA Treatment Reach in 2024. With the lack of water in 2024, water temperatures got too warm on the day we tried to conduct the survey. We completed a single pass and captured the same number of westslope cutthroat as 2023 but only about half the number of brook trout. Our efficiency may have been affected by the warm water temperatures causing a lower capture rate.

Table 14. Electrofishing data collected on South Fork Spotted Dog Creek in 2024. Population estimates (95% CI) are for trout greater than 75 mm (~ 3") in total length. Species abbreviations: WCT = Westslope cutthroat trout, EB = Eastern Brook trout, LN SU = Longnose sucker, SL COT = Columbia Slimy Sculpin.

Section	Species	Population Estimate (Fish/100m)	# Fish Handled	Mean Length (mm)	Length Range (mm)
BDA Treatment Reach	EB		30	143	90-255
	WCT		8	149	89-240
BDA Control Reach	EB	113(104-122)	106	130	84-224
	WCT	37(32-42)	35	122	80-233

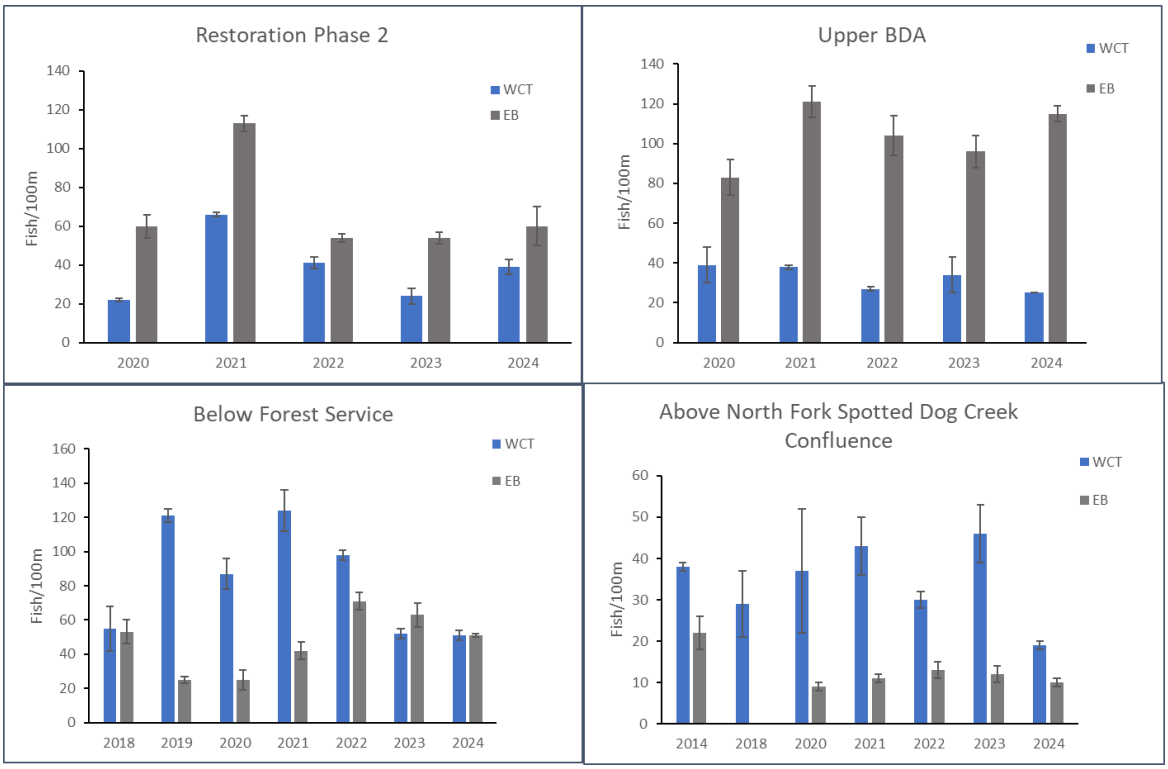


Figure 11. Depletion estimates of westslope cutthroat trout and brook trout at four sites on Spotted Dog Creek.

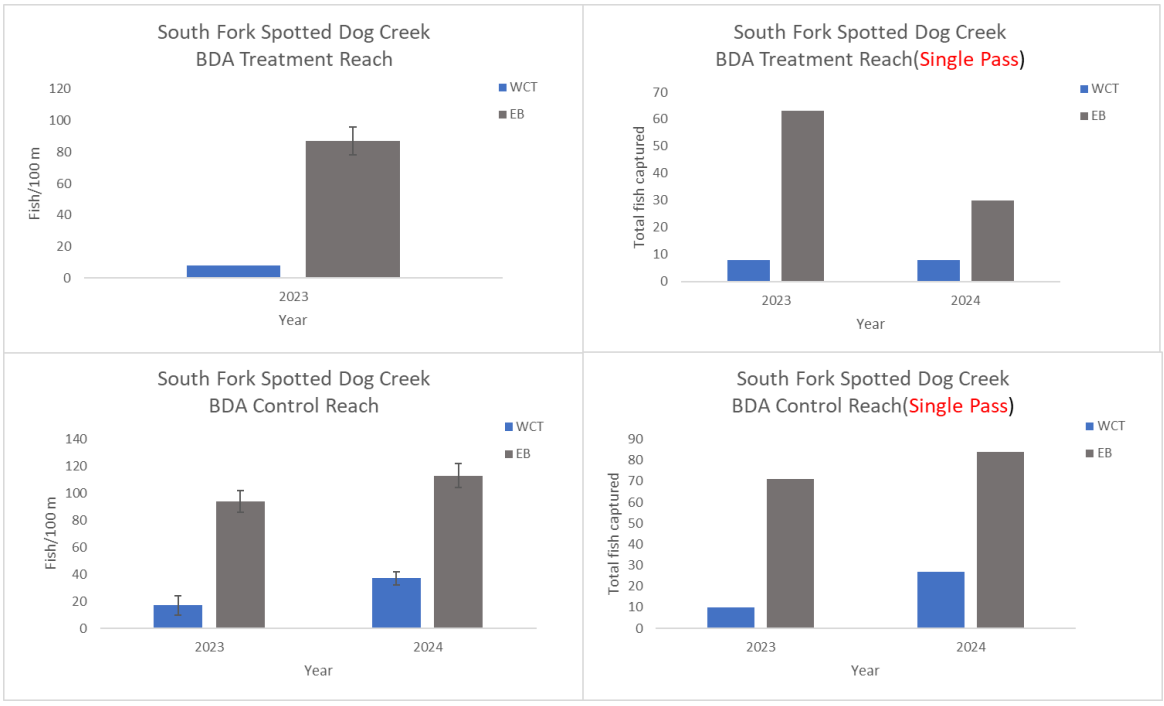


Figure 12. Depletion estimates and single pass surveys of westslope cutthroat trout and brook trout at two sites on South Fork Spotted Dog Creek.

Flint Creek

Three sections were sampled on Flint Creek in 2024 (Table 15). The lowest site near the town of Hall had a brown trout estimate of 308(273-353) fish/km, which is lower than estimates dating back to 2016 (Figure 13). Westslope cutthroat trout were also captured in the Hall section but not enough to produce a valid estimate. The Johnson Tuning Fork section, downstream of Phillipsburg, had a brown trout estimate of 368(339-405) fish/km, which is stable compared to past years data (Figure 13). We were able to produce a rainbow trout estimate of 12(10-20) fish/km, which is consistent with low numbers of Oncorhynchus in the section. The Chor section, upstream of Phillipsburg, had a brown trout estimate of 387 fish/km, which is much lower than the previous estimate in 2021 but higher than other estimates dating back to 2014. We were able to produce an estimate for eastern brook trout of 27(19-51) fish/km, which is similar to previous years (Figure 13.).

Table 15. Electrofishing data collected on Flint Creek in 2024. Population estimates (95% CI) are for trout greater than 175 mm (~ 7") in total length. Species abbreviations: WCT = westslope cutthroat trout, LL = brown trout, EB = Eastern brook trout, RB = rainbow trout, BULL = bull trout.

Section	Species	Population Estimate (Fish/Km)	# Fish Handled	Mean Length (mm)	Length Range (mm)
Hall	EB		1	322	322
	LL	308(273-353)	358	282	150-494
	WCT		20	318	214-389
Johnson Tuning Fork	BULL		1	239	239
	LL	368(339-405)	406	276	158-451
	RB	12(10-20)	15	293	170-407
	WCT		3	340	305-359
Chor	BULL		1	380	380
	EB	27(19-51)	30	226	144-315
	LL	387(369-409)	538	270	151-520
	RB		12	217	155-402
	WCT		2	295	275-317

Figure 13. Mark and recapture estimates for three sections on Flint Creek.

Flint Creek/Allendale Fish Screen PIT Study 2024

To assess fish interactions with the Allendale Canal, the adjacent Private User's Diversions, and fish movement throughout lower Flint Creek, it was decided to employ the use of Radio-frequency identification (RFID) using Passive Integrated Transponder (PIT) technology. This will allow us to characterize fish interactions with the irrigation structures, fish screens, and understand other fish

movements in Flint Creek. The arrays consisted of readers from Oregon RFID powered by 12v deep cycle batteries which were charged by solar panels. The antennas were built with 10-gauge speaker wire encapsulated in ¾ to 2-inch PVC pipe, depending on the antenna configuration. PIT antennas were set up at multiple sites in Flint Creek as well as in the Allendale Canal, at the Private Users headgates, and on the bypass pipes that returned water and fish from the ditches back to the creek. PIT readers were downloaded weekly to monitor fish movement and ensure the readers were working properly.

At the end of the 2022 PIT study antennas were left in the stream over the winter at the mouth site (Map 6) where they were more permanently anchored on the stream bed. New Antennas were anchored below the Private Users Diversion and between the diversions (Maps 7 & 8) in 2023 so they would be in place to monitor fish movement during spring runoff. We continued to run arrays in the Allendale Canal below the headgate and at the fish screen (Maps 7 & 8). In 2024, we added arrays to all the Private User headgates and bypass pipe to confirm fish were being bypassed back to Flint Creek from those ditches (Map 7).

With the expectation of a low water year in Flint Creek due to a low snowpack, it was decided to tag fish in two reaches in lower Flint Creek to observe fish movement in response to drought conditions. Fish were tagged in a section near the town of Hall and a section closer to the mouth below Mullan Road. No new PIT antennas were added for this study.

Map 6. Location of the antenna pair near the mouth of Flint Creek. Multiple antennae are used to gain directionality of fish movement. These antennae are used to monitor fish interaction between Flint Creek and the Clark Fork River.

Map 7. Location of the PIT antennas used to monitor fish movement around the Private Users Diversion and the Allendale fish screen.

Map 8. Location of PIT antennas to monitor fish movement around the Allendale Diversion and the Allendale Canal.

Tagging

Two sizes of PIT tags were implanted in fish. Fish over 200 mm received a 23 mm tag and fish under 200 mm received a 14 mm tag. The read range of the two different size tags was very similar on all antennas. Fish were captured by boat electrofishing, barge electrofishing, backpack electrofishing or angling and then tagged and released. There were several tagging events throughout the year and were mostly done when long term monitoring was already being conducted. Fish were tagged in the Clark Fork River and several different sites in Flint Creek to assess fish movement across the watershed and fish interaction with the Allendale and Private User's diversions.

Tagging events in the Clark Fork coincided with the annual population estimates conducted in April at the Bearmouth, Morse Ranch, Phosphate, Williams Tavenner and Grant Kohrs sites. The first two sites bracket Flint Creek and the other three are between Jens and Deer Lodge. Only westslope cutthroat trout and bull trout were tagged in all sections to assess native fish movement from the Clark Fork River into Flint Creek. A total of 89 westslope cutthroat trout and three bull trout were tagged in the Clark Fork River in 2024 (Table 16). Fish tagging was conducted upstream of Allendale in a section from Henderson Creek Road to Allendale on March 27th and in our long-term monitoring section Johnson Tuning Fork which is between Maxville and Phillipsburg on March 28th. In the Henderson section 62 brown trout, 16 westslope cutthroat trout and one rainbow X westslope hybrid were tagged. In the Johnson Tuning Fork section 57 brown trout and 5 westslope cutthroat trout were tagged. An additional 13 brown trout, 8 westslope cutthroat trout, 1 rainbow X westslope cutthroat hybrid and 1 rainbow trout were tagged above Allendale throughout the summer (Table 17). Westslope cutthroat trout and bull trout were tagged in three long-term monitoring sites during fall population estimates. Seventeen westslope cutthroat were tagged in the hall section, one bull trout and two westslope cutthroat were tagged in the Johnson Tuning Fork section and one bull trout and 2 westslope cutthroat were tagged in the Chor section (Table 18). Westslope cutthroat trout and brown trout were tagged in two sections to assess summer movement related to drought conditions. Two westslope cutthroat and 134 brown trout were tagged below Mullan Road and two westslope cutthroat and 96 brown trout were tagged near Hall (Table 19). In total, 513 fish were tagged in 2024 (Table 20).

Table 16. Number of fish PIT tagged in 2024 from five sections in the Clark Fork River.

Species	CFR Bearmouth	CFR Morse Ranch	CFR Phosphate	CFR Williams Tavenner	CFR Grant Kohrs
Bull trout	3	0	0	0	0
Westslope cutthroat trout	54	21	8	4	2
Total	57	21	8	4	2

Table 17. Fish tagged upstream of Allendale in 2024.

Species	Henderson to Allendale	Johnson Tuning Fork	Above Allendale	Allendale Salvage
Brown trout	62	57	13	0
Westslope cutthroat trout	16	5	8	1
Rainbow X westslope	0	0	1	0
Rainbow trout	0	0	1	0
Total	**78**	**62**	**23**	**1**

Table 18. Fish tagged in Flint Creek long-term monitoring sites.

Species	Hall	Johnson Tuning Fork	Chor
Bull trout	0	1	1
Westslope cutthroat trout	17	2	2
Total	**17**	**3**	**3**

Table 19. Fish tagged for the drought movement study.

Species	Below Mullan Road	Hall
Westslope cutthroat trout	2	2
Brown trout	134	96
Total	**136**	**98**

Table 20. Total number of fish tagged in 2024.

Species	Number of Tags
Bull trout	5
Westslope cutthroat trout	144
Brown trout	362
Rainbow trout	1
Rainbow X westslope	1
Total	**513**

Results

Antennas were installed and operating in Allendale Canal and in the Private Users Diversions when the ditches were opened. While the Allendale headgate was open, a total of 66 tagged fish interacted with the diversion structure. Thirteen fish entered Allendale, 2 entered the Anderson ditch, 5 entered the McGowan ditch and 3 were detected by the bypass antenna and entered an unknown ditch (Table 21). The goal over the past several years has been to monitor fish that moved downstream past the Allendale headgate and determine the percentage of fish that entered Allendale Canal. In 2024, we were able to determine which direction fish were moving. Of the 66 fish that interacted with Allendale diversion, 44 were moving upstream, 17 were moving downstream and 6 made movements both upstream and downstream (Table 22). Of the 13 fish that entered Allendale, 9 were moving upstream when they entered the canal.

Table 21. Fish that moved past antenna between diversions and interacted with the Allendale diversion while Allendale was open.

Species	# Interacted with Allendale	# Entered Allendale	# Entered Anderson	# Entered Conn	# Entered McGowan	# Entered unknow private ditch
Bull trout	1	1	0	0	0	0
Brown trout	28	1	1	0	1	2
Westslope cutthroat trout	28	9	1	0	3	1
Mountain whitefish	7	1	0	0	1	0
Rainbow X westslope	2	1	0	0	0	0
Total	**66**	**13**	**2**	**0**	**5**	**3**

Table 22. Direction that fish were moving when they encountered the Allendale diversion.

Species	Upstream	Downstream	Both
Bull trout	1	0	0
Brown trout	21	6	2
Westslope cutthroat trout	18	7	3
Mountain whitefish	4	3	0
Rainbow X westslope	0	1	1
Total	**44**	**17**	**6**

2024 Flint Creek Fish Movement during Drought

Fish movement from two dewatered portions of Flint Creek between Hall and the mouth was assessed in June 2024. Two separate PIT tagging events were conducted and a barge mounted electrofisher was used to capture and tag fish in the normal long term monitoring section at Hall on June 25th and downstream of Mullan Road on June 26th. PIT antennas were in operation near the mouth of Flint Creek, below the Private User Diversion and between the Private User Diversion and the Allendale Diversion. The study was broken into two time periods. The first was from the date of tagging until the Allendale Canal was closed, the second was after the Allendale Canal was closed. The first period was June 25th-August 15th, and the second was August 16th-September 16th when flows in Flint Creek returned to levels similar to spring levels.

Hall Section

On June 25th, we used a barge mounted electrofisher to capture and PIT tag 96 brown trout and two westslope cutthroat trout. During the time when the Allendale Canal was open and flows reduced in the section, seven brown trout and one westslope moved upstream and were detected on the antennas around Allendale and the Private Users diversions. Fish ranged in size from 240-414 mm. Fish were detected on the antennas around the diversions between July 2nd and July 31st with most detections taking place between July 9th and 13th. During the second period, when Allendale was closed and flows were restored to the section, no fish from the Hall section were detected on any antennas suggesting no

movement out of the section. Nine brown trout were detected on the antennas around the diversions between September 27th and October 26th. Fish ranged in size from 298-392mm. Detections were spread evenly throughout the month of October. No fish moved past the antennas at the mouth during either period.

Below Mullan Road Section

On June 26th, we used a barge mounted electrofisher to capture and PIT tag 135 brown trout and two westslope cutthroat trout. During the time when the Allendale Canal was open and reduced flows in the section, 16 brown trout and one westslope cutthroat trout moved upstream and were detected on the antennas around the diversions. Fish ranged in size from 198-423 mm. Fish were detected on the antennas around the diversions between July 10th and August 13th with most detections taking place between July 10th and 17th. During the second period, when Allendale was closed and flows restored, two brown trout were detected on the antennas around the diversions. Brown trout that were 350 and 442 mm and were detected on the antennas on August 22nd and August 28th. Six brown trout were detected on the antenna around the diversions between September 26th and October 27th.

Fish that were tagged below Mullan Road also moved past the antennas at the during both periods. During the first period when flows were reduced, two brown trout moved past the mouth antennas, one on July 10th and the other on August 8th, these fish were 334 mm and 177 mm respectively. After Allendale was closed and flows were restored, two brown trout moved downstream past the mouth antennas on August 18th and August 26th. The fish were 319 and 392 mm respectively. Two other fish moved out in October and two in November ranging in size from 182-442mm. The largest fish moved from below Mullan Road to the diversions on August 22nd then moved past the mouth antennas on November 18th.

Suspected Causes of Movement

Movement of all species, all tagging locations and movement directions (upstream and downstream) were plotted by week to assess the causes of movements (Figure A). Two significant peaks in trout movement occurred in 2024. The first being in early July (week of July 8th) and the second in late September through early November. The late September through early November movements were clearly primarily spawning movements by brown trout. These spawning movements peaked in mid-October, which coincides well with upstream spawning migrations, as brown trout typically spawn in mid-October through late November in this region of Montana.

The early summer movements were initially detected in mid-June but peaked during the week of July 8 when a total of 23 fish were observed moving near Allendale Diversion and at the station near the mouth (Figure 14). A total of 38 fish made movements either up or downstream from June 16 through July 15 which appeared to be very closely tied to the reduction of streamflow and the increase in max daily temperatures which exceeded 25 C on a large number of days during this period (Figures 14 and 15). Overall, a total of 58 fish were observed moving upstream to Allendale Diversion or downstream to the mouth of Flint Creek throughout the low flow period of June 15 through Sept 15. These 58 fish were of the 235 fish tagged in the two sections and thus approximately 25% of the fish made movements in the low flow period in lower Flint Creek in 2024. Of the four Westslope Cutthroat Trout tagged, two migrated upstream to Allendale Diversion during the low flow period.

The peak in movement during the week of July 8th coincided directly with Flint Creek streamflow dropping below 30 cfs on most days at the Flint Creek USGS gaging station near Mullan Road (Figure 16). As expected, maximum daily temperatures also increased during this period and commonly exceeded 25 C (Figure 15). Water temperatures this high are exceptionally stressful for even brown trout, which is one of the most resilient salmonid species to high water temperatures. Overall, these movements coincided very closely to the beginning of the drought induced low flows observed in 2024 and thus provide evidence that at least a significant number of fish are leaving this reach during drought periods to seek refuge of higher flows (and lower water temperatures) in other parts of the drainage. Flint Creek streamflow remained below 30 cfs until late August.

Movement of tagged fish was disproportionately upstream in 2024 (Figure 14). This is not unexpected, as Flint Creek above Allendale Diversion (Allendale Diversion to the mouth of Trout Creek) has much better instream flow conditions during the irrigation season than other reaches of Flint Creek. This is due primarily to stored water being delivered from East Fork Reservoir (East Fork Rock Creek Drainage) to water users in the lower Flint Creek Valley via a trans-basin diversion. This additional streamflow significantly augments the Upper Flint Creek summer hydrograph and provides high quality habitat for trout in the summer, particularly during drought years. It appears that the PIT tagged trout assessed via this study were utilizing this high flow reach for refuge during the 2024 drought.

The low frequency of downstream movement into the Clark Fork River likely suggests that habitat conditions are also suboptimal for salmonids in the Clark Fork River during the summer. While the Clark Fork River from below Flint Creek to the mouth of Rock Creek does not experience excessive dewatering during irrigation season, high densities of Cladophora spp. (a nuisance algae) and warm summer water temperatures due to simplified habitat (straightened reach with high width to depth ratio) may make this reach less desirable to salmonids during summer conditions. Radio tagged Westslope Cutthroat Trout were found to have low over-summer survival in the Clark Fork River during a previous study and this data suggests that habitat conditions may be poor enough that adult brown trout from Flint Creek also avoid this reach of the Clark Fork River during the summer.

In-stream Flow Target Implications

An in-stream flow assessment was completed in Flint Creek by MFWP in the early 1980's using MFWP's Wetted Perimeter Methodology. Cross sections were collected near the mouth of Flint Creek and via assessment of the flow versus wetter perimeter graph, relatively clear lower and upper inflection points were observed. These inflection points were at 35 cfs and 65 cfs, with an intermediate inflection point at 45 cfs (MFWP 1986).

The inflection points of the wetter perimeter method generally indicate flow targets that maintain a sufficiently wetted cross-section to provide high quality macroinvertebrate production in the surveyed riffles. The inflection points also represent flow targets that provide adequate depth to maintain acceptable adult fish habitat (Nelson 1989), although we are not certain that is accurate in all streams as channel type, temperature, etc… may influence habitat suitability for adult salmonids. Interestingly, 30 cfs appeared to be a trigger point for migration of brown trout out of the Hall to the Mouth reach of Flint Creek. Thus, there was some synergy between our findings and instream recommendations of MFWP (MFWP 1986). Based on the observations that a high level of outmigration occurred at 30 cfs, we recommend target instream targets should significantly exceed this 30 cfs, as conditions may vary between drought years. Conditions such as extremely high air temperatures could make this reach less

tolerable to salmonids during some drought events and instream flows of greater than the lower inflection point (35 cfs) and potentially even the upper inflection point (65 cfs) may be necessary to mitigate these conditions. Based on the results of this tagging study, flow rates at least greater than the lower inflection point (35 cfs) are justified. The influence various streamflow levels have on water temperatures in lower Flint Creek could also be assessed to ensure that instream flow targets adequately address this critical component of habitat conditions.

Hall Diversion

From detections on the antennas around Allendale and other electrofishing efforts, we know fish were able to move over the Hall diversion. From below Mullan Road, there were a total of 23 fish (22 brown trout, 1 westslope) that moved over the Hall diversion while the boards were in. Seventeen while Allendale was open, three after Allendale closed and three that were captured during the population estimates in the Hall section. All that can be said about the three fish that were captured during the population estimate is they moved over the Hall diversion sometime between June 26th and September 24th. Five other brown trout moved past the Hall diversion starting on October 8th. Using the USGS hydrograph near Drummond, it appears that the boards were pulled from the Hall diversion between the October 1st and October 8th.

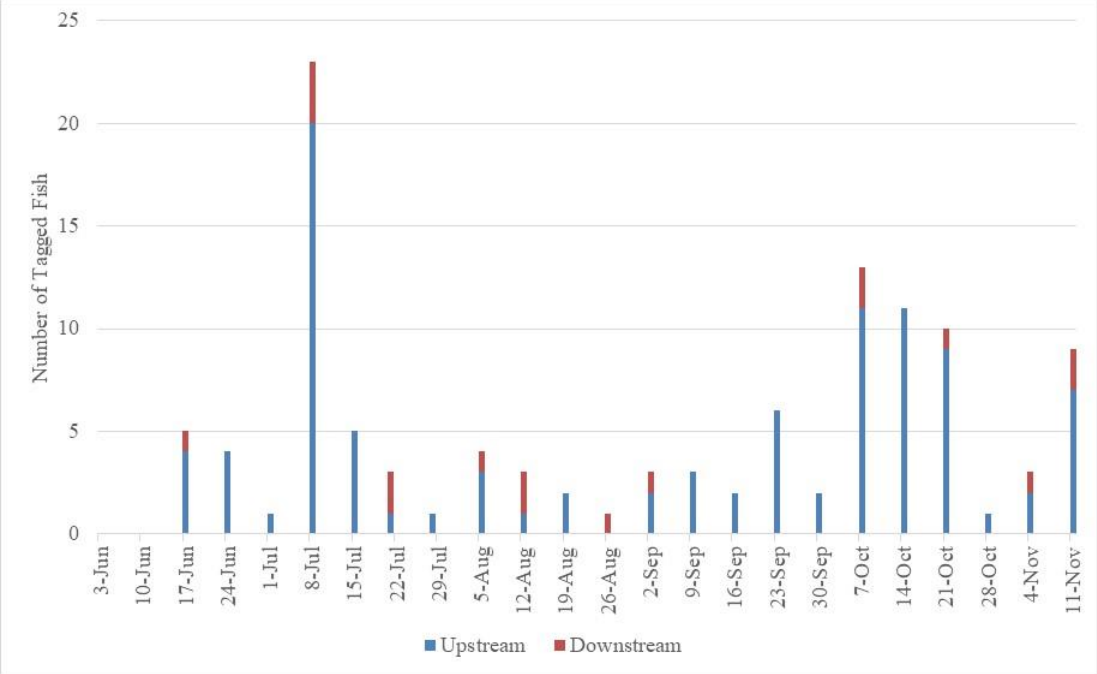


Figure 14. Combined detections of all tagged fish that moved both upstream (detected near Allendale Diversion) and downstream (detected near the mouth) in Flint Creek in 2024.

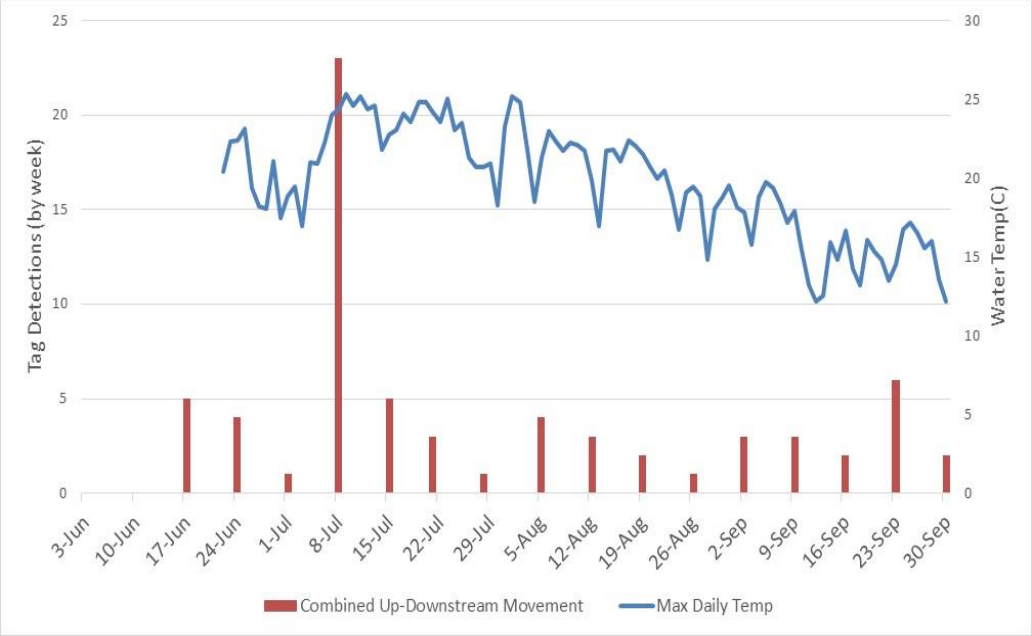


Figure 15. Tag detections for both upstream and downstream movements of tagged trout vs. maximum daily water temperatures (measured at Mullan Road).

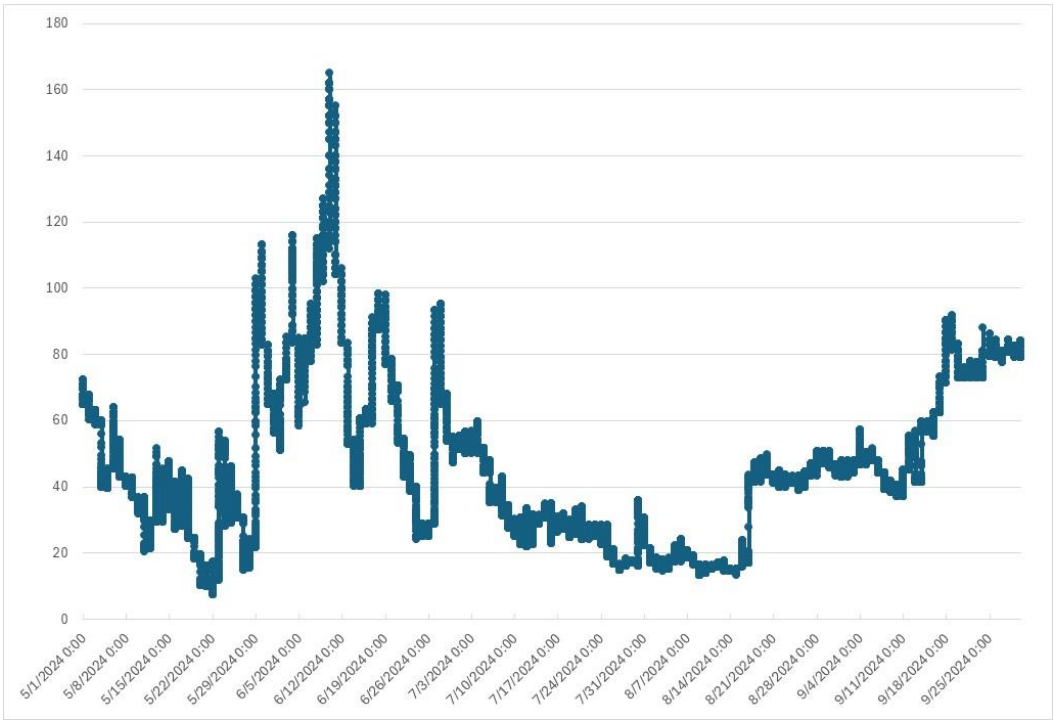


Figure 16. Flint Creek discharge during the 2024 irrigation season at the USGS site at Mullan Road.

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