

Fisheries Monitoring in the Upper Clark Fork River Basin 2020 Report



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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
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 from these activities have 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 than other streams 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 fish to a river where fish they were 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).

In the past, fisheries data collection was conducted sporadically in the UCFRB. From 2008 to 2010, FWP biologists established long term monitoring sections on the mainstem UCFR. FWP has completed population estimates in these 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. In 2014, more sections were added and sampling occurred in both spring and fall. In 2015, the first fish population estimates were attempted on Silver Bow Creek, 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 Silver 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 semi-annually, while smaller tributaries are sampled periodically.

Clark Fork River Mainstem

Population surveys

Trout population estimates are 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 (Figure 1). In addition to the annual sampling sections, we were scheduled to complete population estimates for the entire river from Warm Springs to Rock Creek in 2020. Due to the pandemic, this “all river” sampling was not completed. Instead, we chose to conduct targeted sampling in three sections of reach A in areas of recent or upcoming remediation. The Perkins to Galen section was added in 2019 to provide additional baseline trout population in phases 3 and 4, which will be remediated in the next few years. Perkins to Galen is also the section where a fish kill was documented in fall of 2019 (Cook and Elam 2019). The Galen to Racetrack section was added in 2019 to provide additional post-remediation data in phases 5 and 6. The Grant-Kohrs section was added in 2018 to provide data on the response of the trout fishery to current remedial activities. Perkins to Galen and Galen to Racetrack were sampled in the spring and Grant Kohrs was sampled in the fall.

Fish were collected using aluminum drift boats with a mounted electrofishing unit and two front boom anodes and one netter. Estimates were made using two marking runs and two recapture runs. Recapture runs were completed roughly 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 Parks’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).

Annual Sections

The brown trout estimate at the PH Shack section in 2020 was 83 fish/km (Figure X). The 2020 estimate was well below the 13-year average for this section of 359 fish/km. The highest estimate during the last 13 years at PH Shack occurred in 2013 when the brown trout population was at 1,167 fish/km. The brown trout population at PH Shack declined by 85% from 2013 to 2015 and has remained under 200 fish/km since 2017. At the PH-Shack-to-Perkins Lane section, the 2020 brown trout estimate was 67 fish/km, which was a significant increase from 8 fish/km in 2019. At the below Sager Lane section, the 2020 estimate was 42 fish/km, the lowest estimate recorded at this section. At the Williams-Tavenner section, the 2020 brown trout estimate was 123 fish/km, the lowest estimate since 2009, and significantly lower than the long term average of 192 fish/km at this section. Brown Trout numbers at Phosphate were 164 fish/km in 2020, which is not significantly lower statistically than the section average of 207 fish/km. The 2019

brown trout estimate at the Morse Ranch section was 64 fish/km, which was significantly below the 2009-2020 average of 84 brown trout/km. In addition, the 2020 combined *Oncorhynchus* (WCT, RB, and hybrids) estimate at Morse Ranch was 5 fish/km, which is within the historical range of *Oncorhynchus* estimates for this section. At the Bearmouth section, the 2020 brown trout estimate was 30 fish/km, which is near the average estimate of 31 fish/km. The 2020 *Oncorhynchus* estimate at Bearmouth was 24 fish/km, similar to the long-term average of 24 fish/km.

Targeted Sampling

The Perkins to Galen section was sampled in 2020 for two reasons. First, this is the area in which the fish kill occurred in 2019 and where erosion control measures were installed on some sickens to help avoid future fish kills. The second reason to sample this section was that the upper reaches will be remediated starting in 2021. The 2020 estimate for this section was 26 fish/km, which was up slightly from the 2019 estimate of 19 fish/km, but below estimates done in 2009 and 2015 (Figure X).

Remediation in the Galen to Racetrack section was completed in 2016. The 2020 population estimate for this section was 126 fish/km. Low sampling efficiency and low numbers of recaptured fish complicate statistical comparisons to past estimates at this section, but brown trout numbers do appear down since 2015 (Figure X).

The section in the Grant Kohrs Ranch was sampled in 2018 prior to remediation and 2020 during the late stages of remediation. The 2018 estimate was 154 fish/km and the 2020 estimate was 402 fish/km (Figure X). The 2020 estimate should be interpreted with caution due to low capture efficiency and recapture rate. As a result of low sampling efficiency, the 95% confidence interval for the 2020 estimate at Grant Kohrs is 166-638 fish/km.

Discussion

The brown trout population in the upper reaches of the Clark Fork River are near historic lows. The decline in brown trout numbers is particularly pronounced in sampling reaches upstream of Deer Lodge. Estimates from 2020 were closer to long term averages in lower reach B and reach C compared to reach A. 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 Clark Fork River were tied to flows. Prior to the last few years, 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 (Figure 4). Minimum flow during the brown trout's

first year of life apparently had a significant effect on their survival. From 2002 to 2017, recruitment of age 3 brown trout could be predicted based on previous flow conditions with high precision ($r^2=0.85$). However, since 2018 previous flow conditions are no longer a strong predictor of brown trout numbers in the UCFR.

Several recent developments could be impacting trout numbers in the upper reaches of the Clark Fork River. Reaches of the river above Deer Lodge have extensive slickens and the erosion of these slickens into the river has accelerated in recent years (MTFWP and Clark Fork Coalition 2020). The increased input of metal-laden slicken material into the river is likely deleterious effects on the population. The documented fish kill in 2019 confirmed the lethality of slicken material, not only to trout, but also to mountain whitefish and suckers. Erosion control measures that were installed in 2020 should help to buy time until mine tailings can be removed from the floodplain and banks. However, eroding slickens exist outside of phases 3 and 4 and remediation will not reach some of them for years. High risk slickens should continue to be monitored and mitigation measures should be considered to buy time until cleanup is completed.

Another recent development in the Clark Fork River above Deer Lodge is the remediation itself. 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. These habitat features will eventually reform after remediation, but it is possible that this habitat simplification is contributing to the decline in trout numbers in the UCFR. 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. Compared to previous estimates, the 2020 estimates were lower than average at all but the most downstream section sampled by FWP (Figure X). While habitat simplification will have an effect on fish, particularly at a local scale, it is apparent that other factors have contributed to a more widespread decline.

It is also possible that disease, a warming climate, or a combination of factors could be responsible for the decline in trout numbers in the upper Clark Fork River. Brown trout declines have also recently been reported on the Big Hole, Beaverhead, Ruby, Jefferson, and Madison rivers. FWP does not currently understand why brown trout declines are occurring at a regional, or even state-wide scale, but has formed a working group to look into factors such as drought, disease, angling pressure, high temperatures and other culprits. Whatever factors effecting other Montana brown trout fisheries, some challenges such as acute metal contamination and remedial habitat simplification are unique to the UCFR.

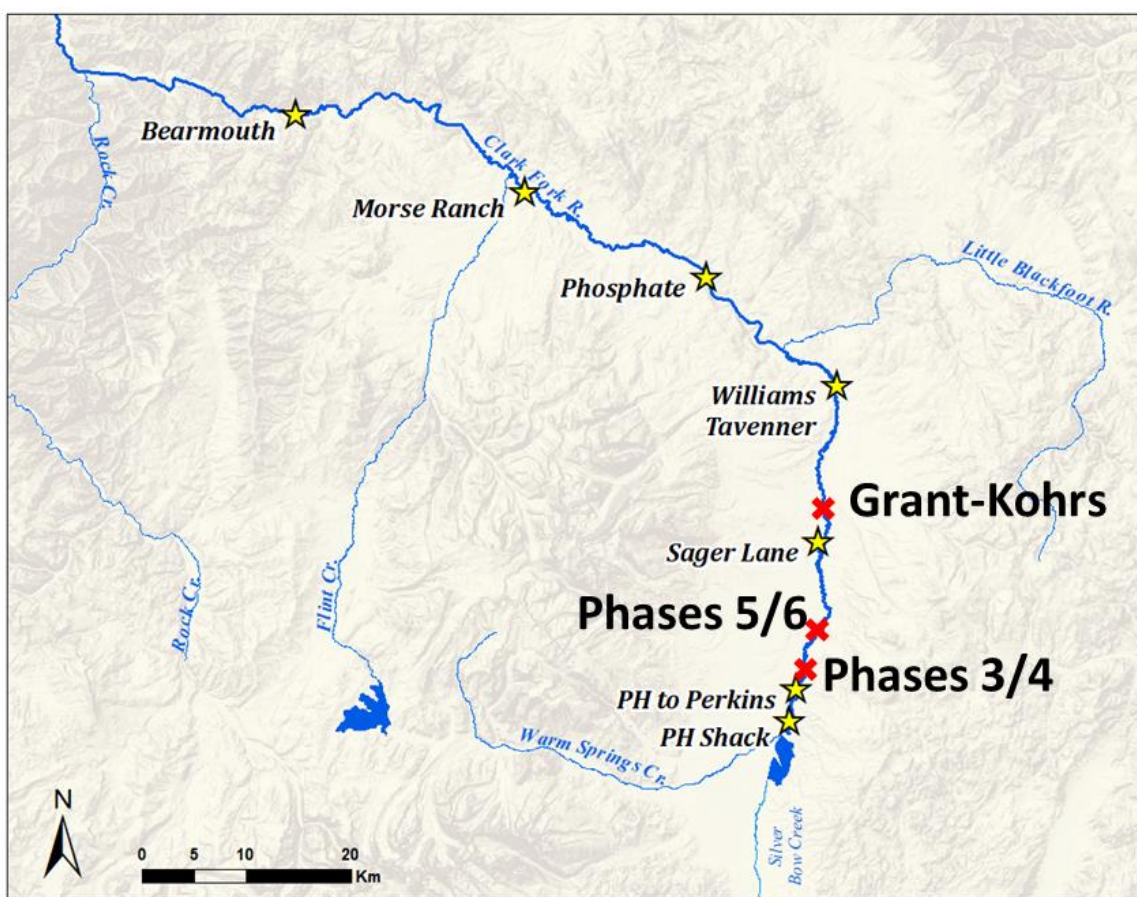


Figure 1. Map of sections of the Upper Clark Fork River sampled in 2020. Established annual sections are denoted by the yellow stars and sections targeting remediation by the red Xs. The Perkins to Galen section is within phases 3/4, the Galen to Racetrack section is within 5/6, and the Grant Kohrs Ranch is within 15/16.

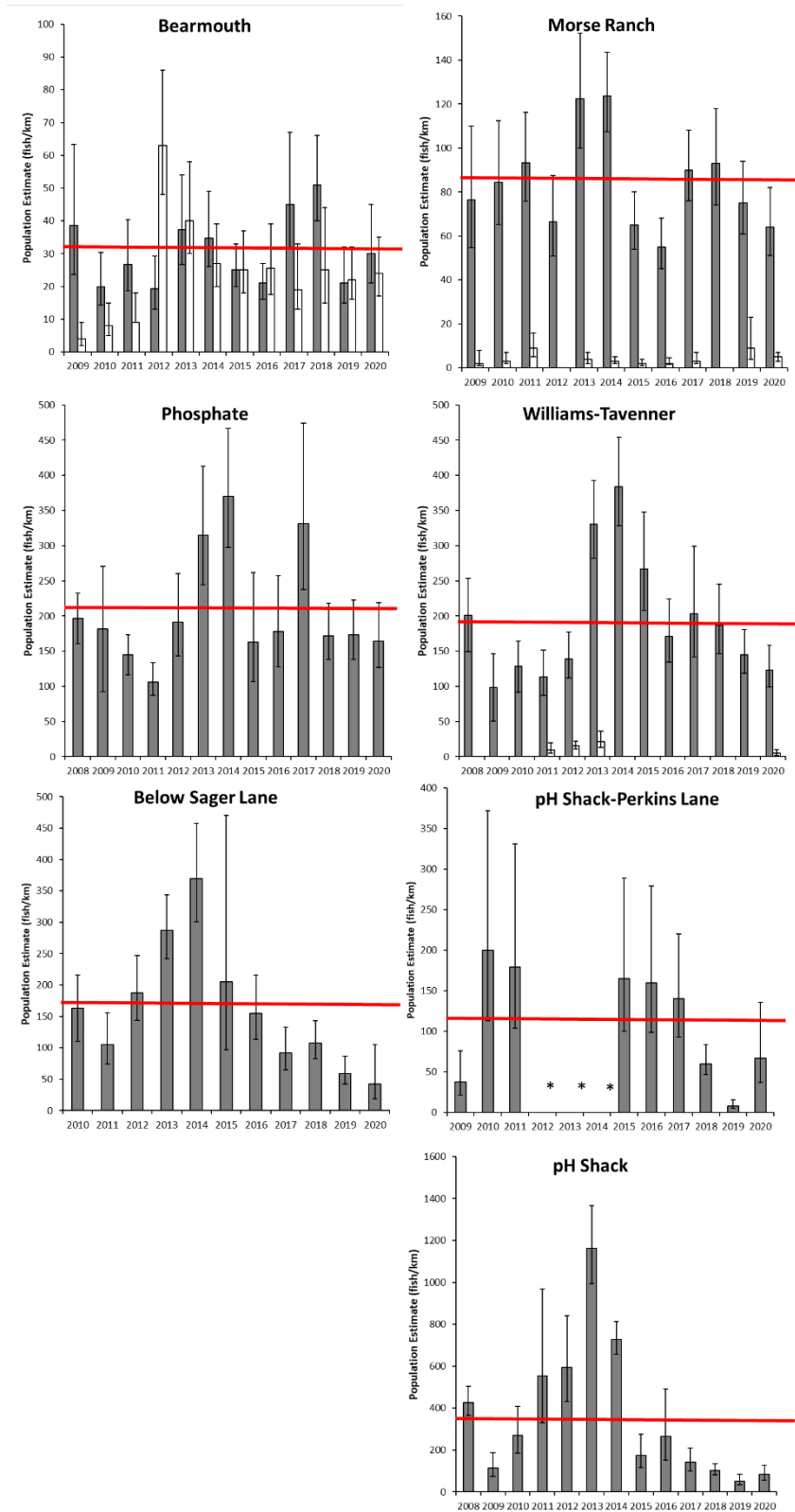


Figure 2. Clark Fork River brown trout (grey bars) and *Oncorhynchus* sp. (white bars) population estimates from 2008-2020 by sample section. Please note that axis values are not the same for every sample reach. The red line depicts the average brown trout population estimate for the section.

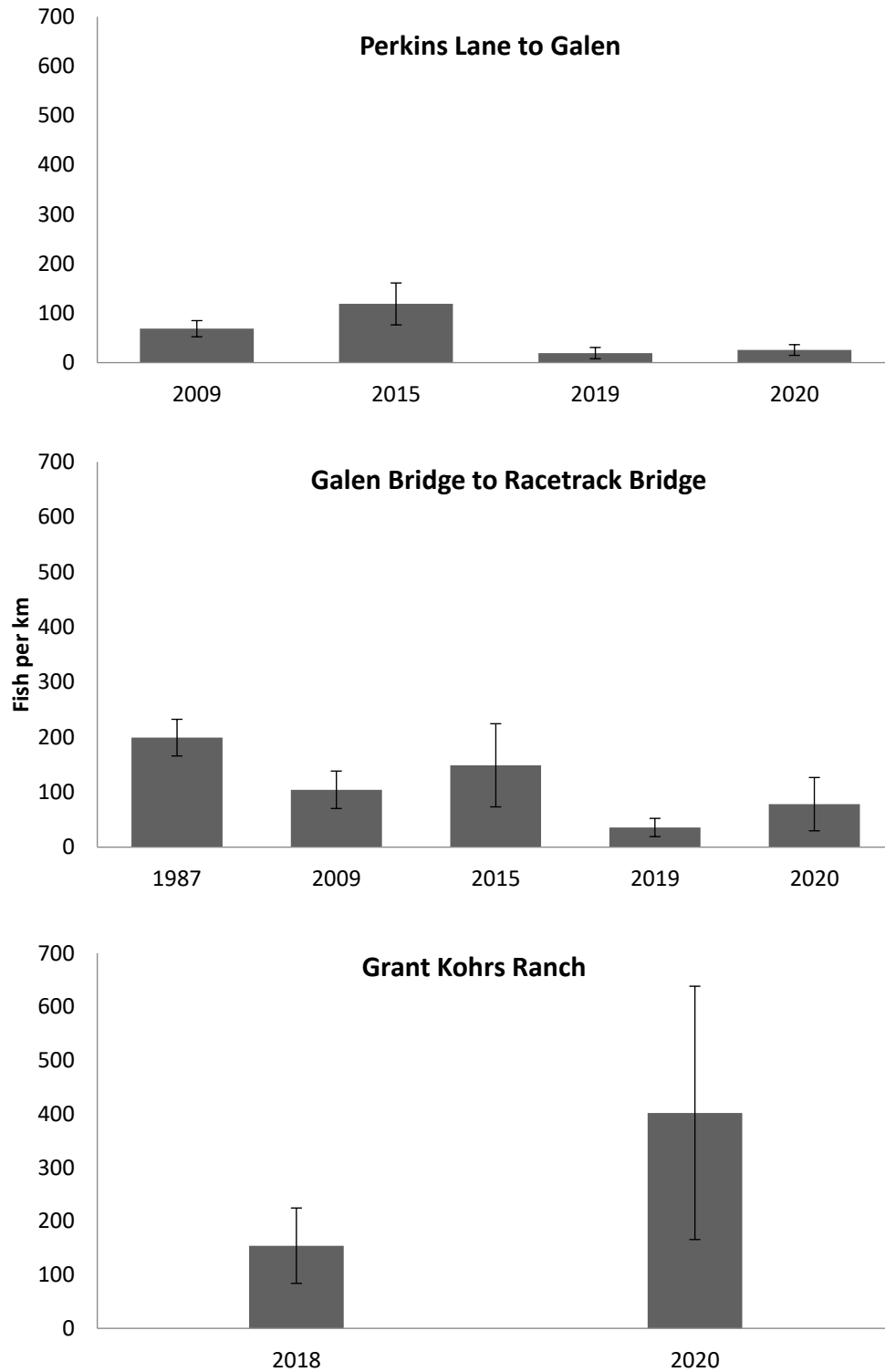


Figure X. Brown trout population estimates at three sampling reaches targeting remediation in the Upper Clark Fork River.

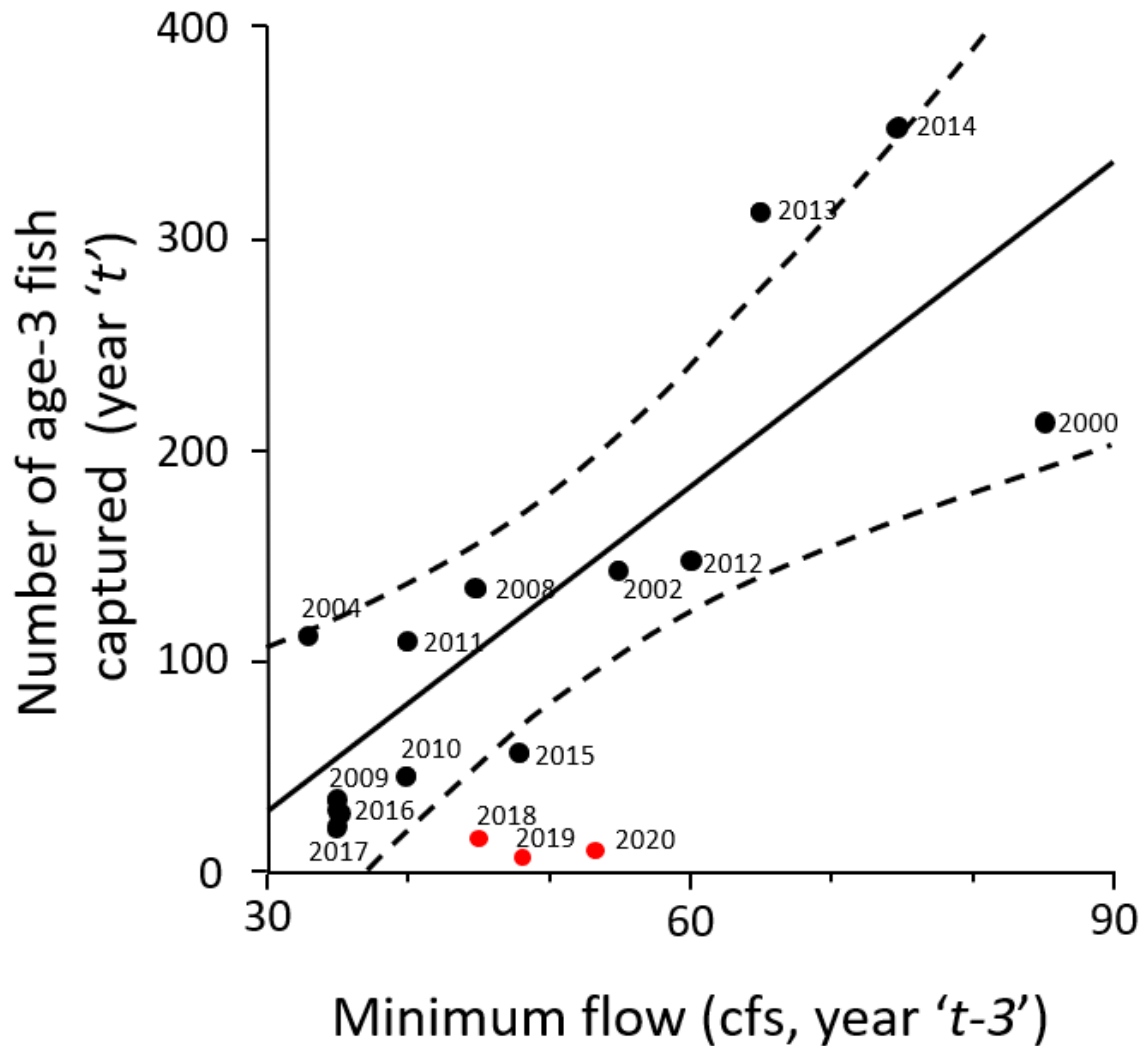


Figure 4. Linear regression of recruitment of age 3 brown trout recruitment versus minimum flow three years prior to sampling. Number of age 3 was captured during electrofishing was considered an index of fish recruitment. Minimum flow was measured at the Clark Fork River at Galen USGS gauge. Data labels are the year fish were sampled. Recruitment data from 2018-2020 were not used in the regression but are included in the chart to show divergence from the model.

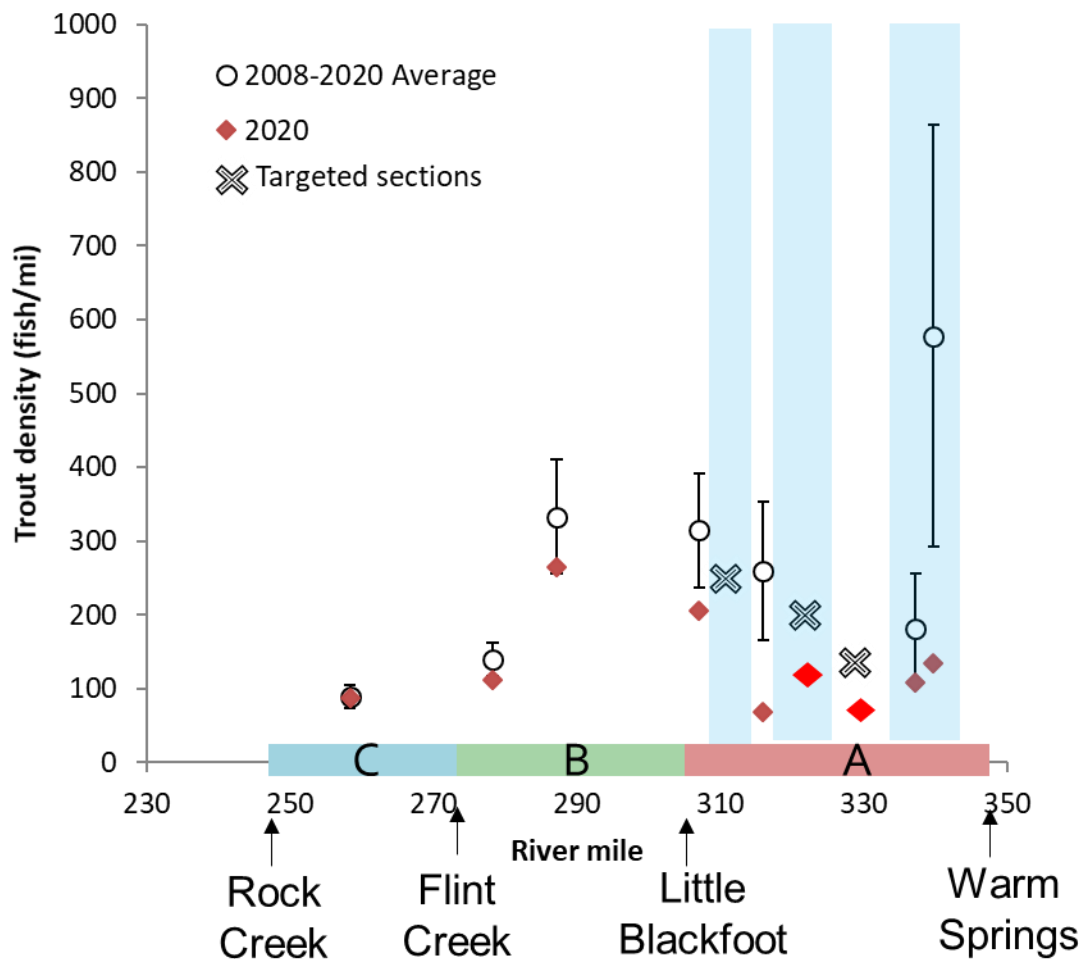


Figure X. Brown trout population estimates for 10 sampling sections on the Upper Clark Fork River. Average estimates (and 95% CI) over all years for annual sections are depicted by open circles and Xs for sections targeting remediation. Due to the limited number of years sampled, no confidence intervals are given for targeted sections. Estimates from 2020 are red dots. The spurious estimate from the Grant-Kohrs section in 2020 was not included. Boundaries of reaches A, B, and C and corresponding tributaries are indicated on the x-axis.

Silver Bow Creek

Sampling strategy

Fisheries monitoring in Silver Bow Creek began in earnest when the first fish (sucker and sculpin) 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 Effort or CPUE). Starting in 2019, fish sampling was further complicated by an increase in 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. In order 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 water conductivity, were very difficult to sample with backpack units.

Sampling summary

Currently, seven sections of Silver Bow Creek are sampled annually. All seven sections are sampled in the summer and the LAO and Ramsay sections are sampled again in the fall. Catch per unit effort data for the summer sampling are presented in Table 1 and fall sampling in Table 2. The most downstream section is just above the HWY 1 bridge.

The HWY 1 section is characterized by consistently low trout densities, comprised of RB, WCT, and EB. Longnose and largescale suckers, rocky mountain sculpin, and reidside shiner have also been captured at this section. Rainbow trout, longnose suckers, and sculpin were first detected at his section in 2008. Westslope cutthroat were first detected in 2010 at HWY 1.

The Fairmont Section was first sampled in 2014. The trout population in this section is comprised of westslope cutthroat trout, rainbow trout, a few brook trout. Longnose and largescale suckers, rocky mountain sculpin, and redbside shiner have also been captured at this section. A mark-recapture estimate was done in September 2020 in an expanded section at Fairmont. This sampling yielded an estimate of 108 WCT/km (65-209 95% CI). Estimates of other species could not be generated due to low numbers of recaptures.

The German Gulch section has the highest densities of WCT during the summer of all Silver Bow Creek sampling sections. Catch rates of both WCT and EB in the fall tend to be lower in the German Gulch Section compared to summer (Figure X). This fall reduction in trout catch rates can be attributed to fish redistributing to other parts of Silver Bow Creek (such as the Ramsay area) as water temperatures cool down. Other species captured in the German Gulch Section of Silver Bow Creek include longnose suckers, rocky mountain sculpin, and central mudminnow. A mark-recapture estimate was done in September in an expanded section below German Gulch. This sampling yielded an estimate of 148 WCT/km (113-205 95% CI) and 51 EB/km (27-115 95% CI). Estimates of other species could not be generated due to low numbers of recaptures.

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 is characterized by moderately high trout densities during the fall and low densities during the summer. Trout catch rates during the fall at Ramsay are similar to catch rates at the sampling section below German Gulch (Figure X). However, during summer sampling trout catch rates at Ramsay go down while catch rates go up at German Gulch during summer sampling. Trout catch rates in 2020 were likely artificially low due to high water conductivity. 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 the fish barrier.

At the Rocker section, low numbers of trout are typically captured in both the spring and fall sampling. Westslope cutthroat trout were first captured at the Rocker section in 2010 and brook trout were first captured in 2011. Summertime catch rates of longnose suckers have decreased from 2016 to 2020, while catch rates of sculpin have increased over this time. Central mudminnow have also been captured at the Rocker 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 in 2009. Brook trout tend to outnumber westslope cutthroat trout 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.

Brook trout, longnose suckers, and sculpin were first captured in the Father Sheehan section of Blacktail Creek in 2005. Despite sampling nearly every fall, westslope cutthroat trout were not captured at Father Sheehan until 2013. This section of Blacktail Creek currently contains small numbers of native cutthroat trout. However, it does support a robust brook trout population. Brook trout population estimates were generated from 2015-2017 and again in 2020 (Figure X). These estimates ranged from 75-185 fish/100m. Longnose suckers, sculpin, central mudminnow, and one goldfish have also been captured at Father Sheehan.

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 in particular is a critical spawning stream for westslope cutthroat trout and brook trout. Given the high numbers of brook trout in the Father Sheehan section, it is clear 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 areas of the tributary. 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. However, it is clear that conditions in Silver Bow Creek within and immediately downstream of Butte are not conducive to supporting trout fisheries year-round.

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 cutthroat trout 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 waste water treatment plant was improved in 2015 and 2016 (Nagisetty et al. 2019). However, nighttime DO concentrations are likely 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.

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 is 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.

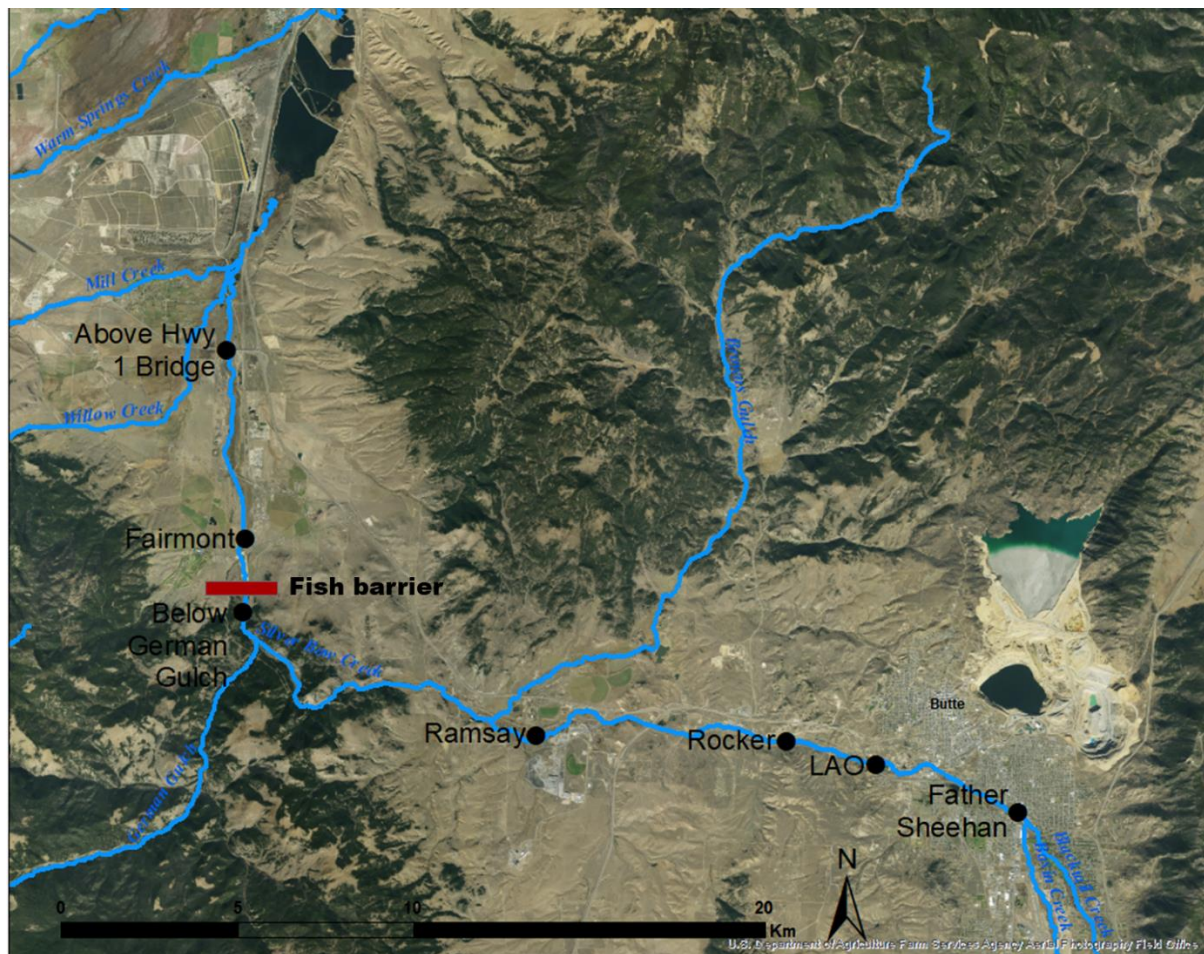


Figure X. Map of seven annual fish sampling sections on Silver Bow Creek.

Table 1. Fish captured per minute of electrofishing in six sampling sections on Silver Bow Creek during spring and summer. Data from spring surveys are in grey, summer in white. *2020 sampling at the German Gulch and Fairmont sections were done with a barge-mounted electrofisher and throwable anodes. As a result, fish capture efficiency is likely much higher for these surveys compared to other Silver Bow Creek surveys that were conducted with backpack electrofishing.

Section	Species	Summer	Spring		Summer				
		2007	2014	2015	2016	2017	2018	2019	2020
LAO	WCT	n/a	0	0.058	0.055	0.032	0.045	0.078	0.065
	EB	n/a	0.600	0.404	0.137	0.016	0.112	0.078	0.236
	LN SU	n/a	0.917	0.029	0.082	0.016	0.022	0	0.000
	RM COT	n/a	1.164	0.115	1.261	4.319	1.902	2.685	3.997
	CM MN	n/a	0	0	0	0	0.045	0.103	0.000
Rocker	WCT	n/a	0.539	0.059	0.054	0.016	0	0	0.017
	EB	n/a	0.054	0.118	0	0	0	0	0.017
	LN SU	n/a	1.831	1.298	2.370	0.774	1.331	0.939	0.247
	RM COT	n/a	0.054	0.059	0	0.033	0.258	2.782	3.079
	CM MN	n/a	0	0	0.018	0	0.129	0.759	0.000
Ramsay	WCT	n/a	0.654	0.214	0.039	0.014	0.153	0	0.017
	EB	n/a	0.187	0.123	0	0	0	0	0.052
	LN SU	n/a	0.187	0.092	1.090	1.190	0.561	0.376	0.115
	RM COT	n/a	0.047	0.398	0.350	0.969	0.238	0.716	1.690
	CM MN	n/a	0	0	0	0	0.051	0	0.000
German Gulch	WCT	0.057	0.235	0.029	0.372	0.492	0.335	0.466	*1.097
	EB	0.143	0.209	0	0.107	0.164	0.129	0.380	*0.627
	LN SU	0.429	0.078	0.059	0.149	0.048	0	0.012	*0
	RM COT	0.200	0.313	0.117	1.247	1.400	0.412	0.761	*0
	CM MN	0.029	0.026	0	0	0	0	0	*0
Fairmont	WCT	n/a	n/a	0.126	0.198	0.610	0.119	0.264	*0.516
	EB	n/a	n/a	0.157	0.446	0.376	0.089	0.081	*0.129
	RB	n/a	n/a	0.063	0	0.023	0	0	*0.086
	LN SU	n/a	n/a	0.094	0.278	0.106	0.015	0.020	*0.172
	LS SU	n/a	n/a	0	0	0	0	0.020	*0.086
	RM COT	n/a	n/a	0.659	1.259	2.430	0.637	2.298	*0
	RS SH	n/a	n/a	0	0.020	0.012	0.741	0.692	*0
HWY 1	WCT	n/a	0.093	0.090	0	0.024	0.051	0.022	0.115
	EB	n/a	0.327	0.180	0.017	0.060	0.051	0	0.016
	RB	n/a	0.373	0	0.017	0.012	0.051	0	0.033
	LN SU	n/a	0	0	0.808	0.384	0.137	0.022	0.066
	LS SU	n/a	0	0	0	0.132	0.274	0.022	0.016
	RM COT	n/a	0.233	0.135	0.791	0.961	0.292	0.811	0.640
	RS SH	n/a	0	0	0	0.096	0.137	0	0.016

Table 2. Fish captured per minute of electrofishing in seven sampling sections on Silver Bow Creek during fall surveys. Although it is not sampled in the fall and it is not within Silver Bow Creek, data from the Father Sheehan section of Blacktail Creek is included in this table to allow for comparison to other long-term datasets. Surveys at Father Sheehan were in done in spring prior to 2015 (spring data in grey), but were more recently conducted during August (bold). Catch rates at the Ramsay section were likely reduced in 2020 due to high water conductivity (~1200 µc/cm).

Section	Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Father Sheehan	WCT	n/a	n/a	n/a	0	n/a	0	0	0	0	0	0	0.054	0	0	0.012	0.012	n/a	0	0.029
	EB	n/a	n/a	n/a	1.140	n/a	1.398	2.154	3.528	3.876	3.438	7.080	7.621	3.337	3.194	2.386	1.485	n/a	3.190	2.942
	LN SU	n/a	n/a	n/a	0.600	n/a	1.290	0.306	0.042	0.408	0.186	0.192	0.027	0	0.132	0.136	0.344	n/a	0.394	0.108
	RM COT	n/a	n/a	n/a	2.280	n/a	2.910	2.154	1.548	1.122	1.242	1.440	0.403	0.303	0.015	0.049	0.196	n/a	1.241	0.902
	CM MN	n/a	n/a	n/a	0	n/a	0.852	0.408	0.258	0.168	0.078	0.030	0	0	0	0.037	0.012	n/a	0.197	0.039
	GDF	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.020	n/a
LAO	WCT	n/a	n/a	n/a	0	0	0	0	0.030	0	0.042	0	0	0.037	0.026	0.081	0.083	0	0.071	0.102
	EB	n/a	n/a	n/a	0	0	0.060	0	0.066	0.570	0.438	0.198	0.117	0.225	0.103	0.190	0.083	0.092	0.024	0.102
	LN SU	n/a	n/a	n/a	7.200	1.860	0.846	0.996	0.618	0.258	0.042	1.512	0.381	0.037	0	0.027	0.111	0.642	0	0.000
	RM COT	n/a	n/a	n/a	0.444	4.140	4.668	2.772	2.256	0.858	0.120	2.778	2.490	0	1.806	1.520	0.473	0.275	0.686	1.226
	CM MN	n/a	n/a	n/a	0.096	0.084	0.204	0.144	0.228	0	0.042	0	0	0.037	0	0	0	0	0.024	0.000
Rocker	WCT	0	0	0	0	0	0	0	0	0.120	0.072	0	0.064	0	0.037	0	0.058	0.030	n/a	n/a
	EB	0	0	0	0	0	0	0	0	0	0.138	0	0	0.048	0.037	0.045	0.019	0.060	n/a	n/a
	LN SU	2.940	1.800	0.720	2.820	5.220	2.610	5.352	1.362	8.238	6.564	13.038	2.708	3.033	3.164	3.048	0.637	0.060	n/a	n/a
	RM COT	0.060	0.036	0.036	0	0.096	0.120	0	0.036	0.060	0	0.186	0	0	0.037	0	0.039	0.360	n/a	n/a
	CM MN	0	0	0	0	0	0	0	0	0	0	0	0	0	0.389	0.045	0	0	n/a	n/a
Ramsay	WCT	n/a	0	0	n/a	0	0	0.078	0.174	0.312	0.624	0.360	0.692	0.460	0.214	0.284	0.155	0.387	0.234	0.0483
	EB	n/a	0	0	n/a	0	0.030	0.036	0	0.036	0	0	0.099	0.276	0.300	0.109	0	0.129	0.039	0.0967
	LL	n/a	0	0	n/a	0	0	0	0	0	0	0	0	0	0	0.022	0	0	0	0
	LN SU	n/a	0	0	n/a	4.320	1.206	1.212	0.300	0.156	0.228	0.450	0.395	0.046	0.815	0.327	0.291	0	0.098	0.0725
	RM COT	n/a	0	0	n/a	0.060	0.084	0.192	0.042	0	0	0.048	0.049	0.092	0.129	0.851	0.310	0.022	0.176	0.3866
	CM MN	n/a	0	0	n/a	0	0	0	0	0	0	0	0	0.046	0	0	0	0	0	0
German Gulch	WCT	n/a	0	0	0	0	0.048	0.066	0.042	0.072	0.078	0.564	n/a	0.499	0.081	0.146	0.362	0.280	n/a	n/a
	EB	n/a	0	0	0	0.030	0.906	0.066	0.126	0.570	0.360	0.390	n/a	0.160	0.067	0.063	0.019	0.117	n/a	n/a
	LN SU (w/LS)	n/a	0	0	0.030	0.300	1.068	1.128	0.192	1.278	0.150	0.486	n/a	0.120	0.054	0	0	0	n/a	n/a
	RM COT	n/a	0	0	0.090	0.084	0.420	0.126	0	0.180	0.036	1.356	n/a	0.619	0.364	0.335	0.133	0.280	n/a	n/a
	CM MN	n/a	0	0	0	0	0	0	0	0	0	0	n/a	0	0	0	0	0	n/a	n/a
Fairmont	RB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0.147	0.016	0	n/a	n/a
	WCT	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.402	0.091	0.213	0.441	0.221	n/a	n/a
	EB	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.369	0.195	0.213	0.063	0.080	n/a	n/a
	LN SU (w/LS)	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.168	0.052	0.295	0.409	0	n/a	n/a
	RM COT	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.067	0.507	0.950	0.063	0.080	n/a	n/a
	RS SH	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0.110	0	n/a	n/a
HWY 1	RB	n/a	n/a	n/a	n/a	n/a	n/a	0.072	0.108	0.192	0.042	0.048	0.272	0.036	0.019	0.116	0.083	0.068	n/a	n/a
	WCT	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0.048	0	0	0	0.109	0	0.116	0.062	0	n/a	n/a
	EB	n/a	n/a	n/a	n/a	n/a	n/a	0	0.036	0	0.078	0.198	0.194	0	0.057	0.070	0.041	0	n/a	n/a
	LN SU (w/LS)	n/a	n/a	n/a	n/a	n/a	n/a	0.420	0.036	0	0.078	0.048	0	0.036	0.057	0.046	0.021	0	n/a	n/a
	RM COT	n/a	n/a	n/a	n/a	n/a	n/a	0.534	0.216	1.998	0.312	1.080	0.155	0.253	0.439	0.279	0.021	0.045	n/a	n/a
	RS SH	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0.023	0	0	n/a	n/a

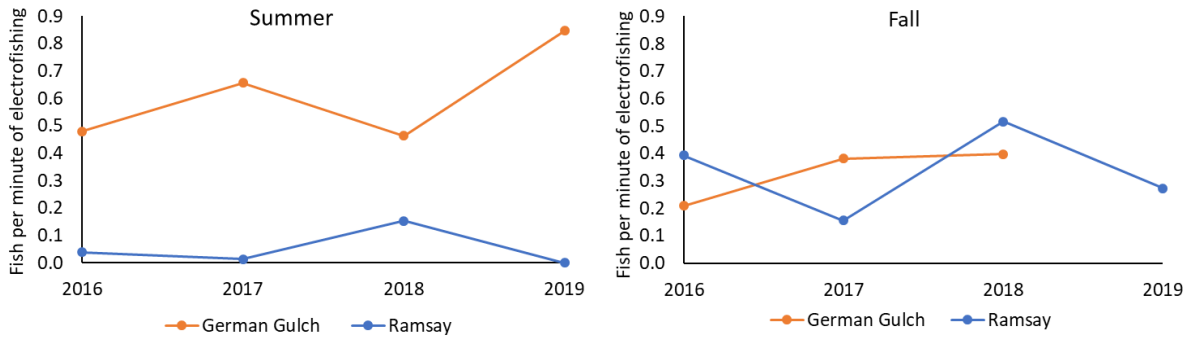


Figure X. Catch rates (trout captured per minute of electrofishing) at the German Gulch and Ramsay sections of Silver Bow Creek. Catch rates of westslope cutthroat trout and brook trout are combined. The German Gulch section was not sampled in fall 2019.

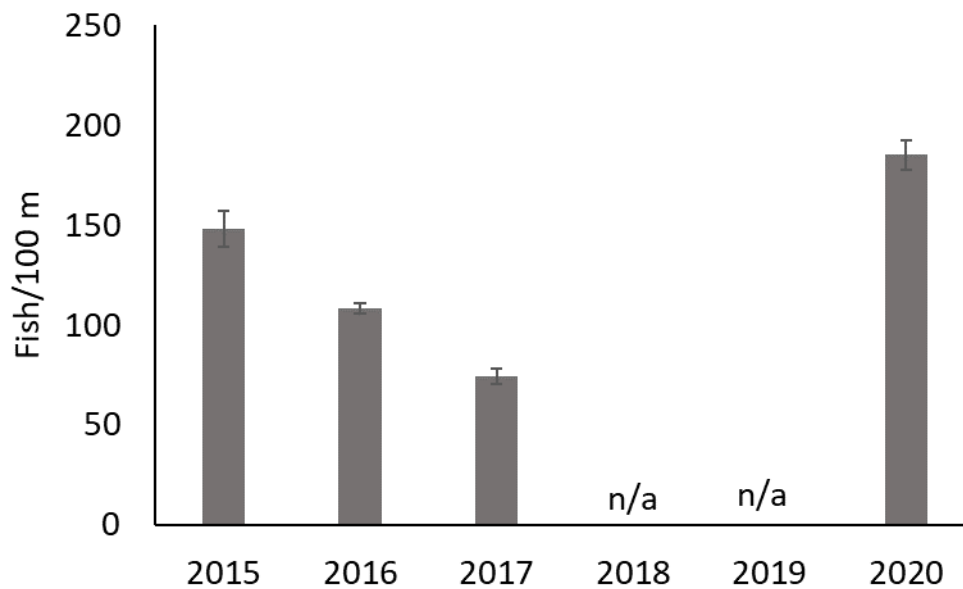


Figure X. Brook trout population estimates at the Father Sheehan section of Blacktail Creek.

Cottonwood Creek Watershed

Four sections of Cottonwood Creek (including the Middle Fork) and one section of Baggs Creek were sampled in 2020. The most downstream section is within the town of Deer Lodge and is at River Mile 0.8. This section of Cottonwood Creek is an obvious nursery area for brown trout as numerous young-of-year LL have been captured there every year. In 2020 the LL estimate was 90 fish/100 m (95% CI = 75-105). This LL estimate was comparable to 2016 and 2017 (Figure X). In 2020, two brook trout and one westslope cutthroat trout were also captured. This was the first year since monitoring began in 2014 that a WCT was detected at this section.

The sampling section at River Mile 3.0 is heavily dewatered during late summer, which is when fish sampling occurs. Trout numbers in the past have been too low to generate population estimates, so fish captured on one electrofishing pass is used as an index of abundance. Flow in this section was improved in 2020 compared to previous years. Prior to 2020, the most brown trout captured in this section was 10 fish. In 2020, 27 brown trout were captured. Similarly, 67 brook trout were captured in 2020 compared to the previous high of 5 fish. Trout in this section were apparently taking advantage of more water than what has been available previously in this reach of Cottonwood Creek.

At the River Mile 6.9 section, the 2020 WCT estimate was 27 fish/100 m (23-31), which is the lowest WCT estimate at this section since monitoring began in 2015. The brook trout estimate was 29 fish/100 m (23-35) in 2020. This section has undergone significant changes to the streambed and several pools have filled in over time.

The monitoring section on the Middle Fork Cottonwood Creek (RM 0.7) has a relatively abundant population of WCT, with WCT estimates > 80 fish/100 m since population estimates began in 2015. The 2020 WCT estimate at this section was 135 fish/100 m (129-141). The EB estimate was 15 fish/100 m (14-16) in 2020.

One sampling section on Baggs Creek at River Mile 2.4 has been monitored since 2015. This section is on USFS property and is upstream of irrigation diversions. In 2020 the WCT estimate at this section was 29 fish/100 m (28-30), which is significantly lower than any previous year. The EB estimate for 2020 was 65 fish/100 m (56-75). The reason for reduced WCT abundance at this section is unclear.

Table 3. Electrofishing data collected in the Cottonwood Creek watershed in 2020. Population estimates (95% CI) are for trout greater than 75 mm (~ 3”) in total length.

Section	Species	Population Estimate (fish/100m)	# Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
School RM 0.8	LL	90 (75-105)	91	207	45-425	97
	EB		2	208	169-246	2
	WCT		1	280		1
Middle RM 3.0	LL		27	115	52-184	26
	EB		67	107	50-128	64
	SL COT		11			10
Upper RM 6.9	WCT	27 (23-31)	46	149	65-256	63
	EB	29 (23-35)	27	104	42-239	37
Middle Fork	WCT	135 (129-141)	147	120	59-211	88
	EB	15 (14-16)	20	112	40-200	12
Baggs Creek RM 2.4	WCT	29 (28-30)	38	145	66-235	37
	EB	65 (56-75)	68	112	74-208	63

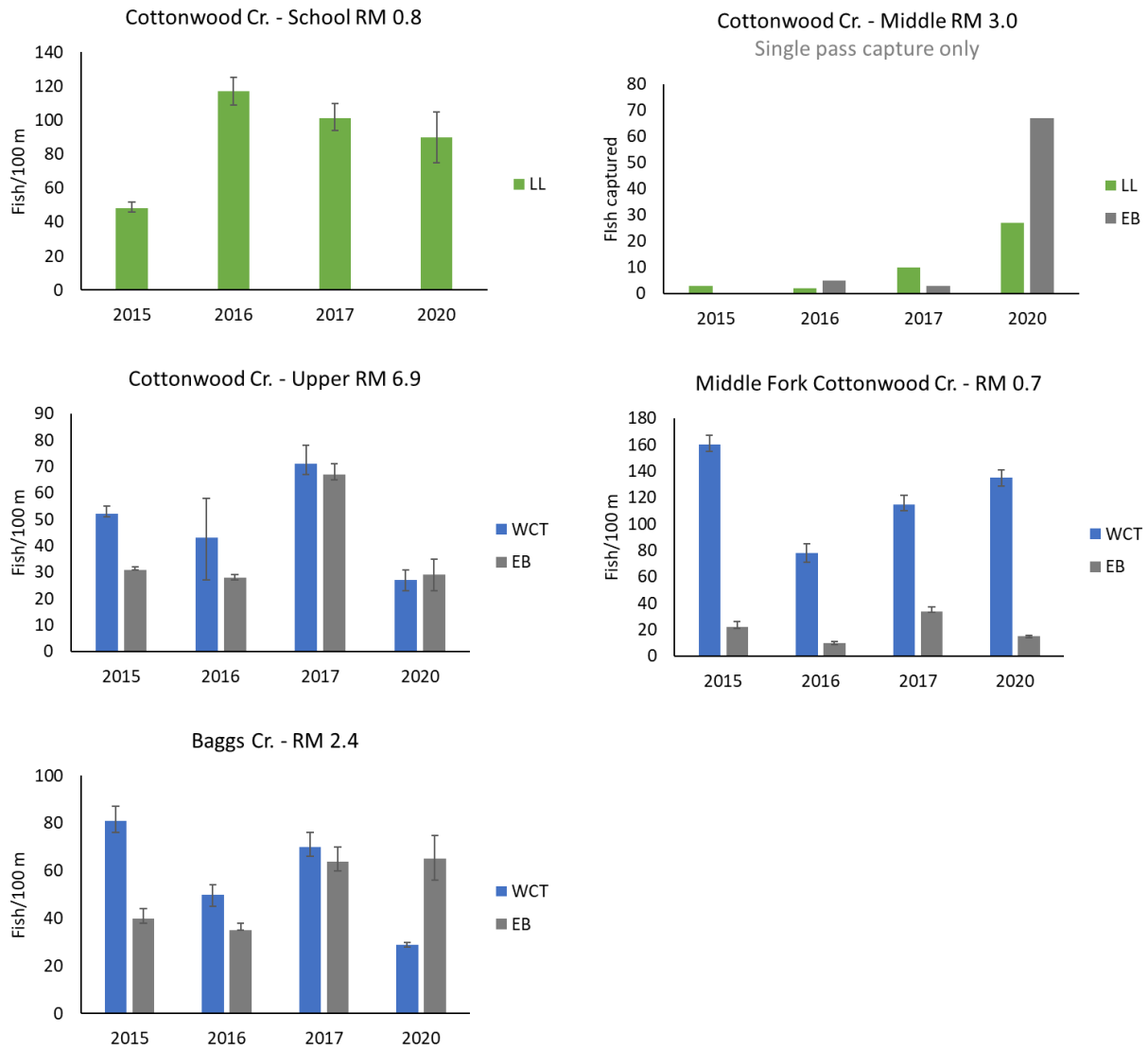


Figure 13. Cottonwood Creek population estimates for fish ≥ 75 mm. Error bars are 95% CI.

O'Neill Creek

Four sections of O'Neill Creek were sampled in 2020. Two of these sections are on private land in the lower mile of the creek and had not been surveyed for fish prior to 2020. The upper two sections are within the Spotted Dog WMA and had been surveyed 3-4 times since 2015. At the most downstream section (Lower Benson, River Mile 0.4), The westslope cutthroat trout estimate was 23 fish/100 m (95% CI = 19-27). One brook trout was also captured. Most WCT captured were juveniles (average length = 128 mm), but a few larger individuals were also present. At the Upper Benson Section (RM 1.0), the WCT estimate was 52 fish/100 m (41-63). No other species were captured. At the Above Road Crossing Section (RM 1.7), the WCT estimate was 54 fish/100 m (41-67). The most upstream section is at RM 2.9 and is just below a large waterfall. The WCT estimate at the Below Falls Section was 149 fish/100 m (144-155). This population estimate was in the range of previous estimates at the Below Falls Section.

Despite its small size, O'Neill Creek is a highly productive source of westslope cutthroat trout. Juvenile WCT are very abundant in all sections of O'Neill Creek. Except for one brook trout captured in 2020 in the most downstream section, WCT are the only species that have been captured in O'Neill Creek. The general absence of nonnative fishes is rare in tributaries of the Clark Fork River. It is also rare for tributaries to lack species such as sculpin. It may be worthwhile to investigate the mechanisms that keep fishes other than WCT out of O'Neill Creek. A culvert that goes under I-90 is a potential barrier, but telemetry studies have shown WCT can navigate this structure and move upstream to spawn (Mayfield 2013).

Table 4. Electrofishing data collected from O'Neill Creek in 2020. Population estimates (95% CI) are for trout greater than 75 mm (~ 3") in total length.

Section Name/RM	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)	Estimate per 100m
Lower Benson	WCT	22	96	97-195	128	26	23 (19-27)
	EB	1	4		148		
Upper Benson	WCT	47	100	74-215	123	23	52 (41-63)
Above Road Crossing	WCT	47	100	75-172	116	19	54 (41-67)
Below Falls	WCT	119	100	63-228	124	23	149 (144-155)

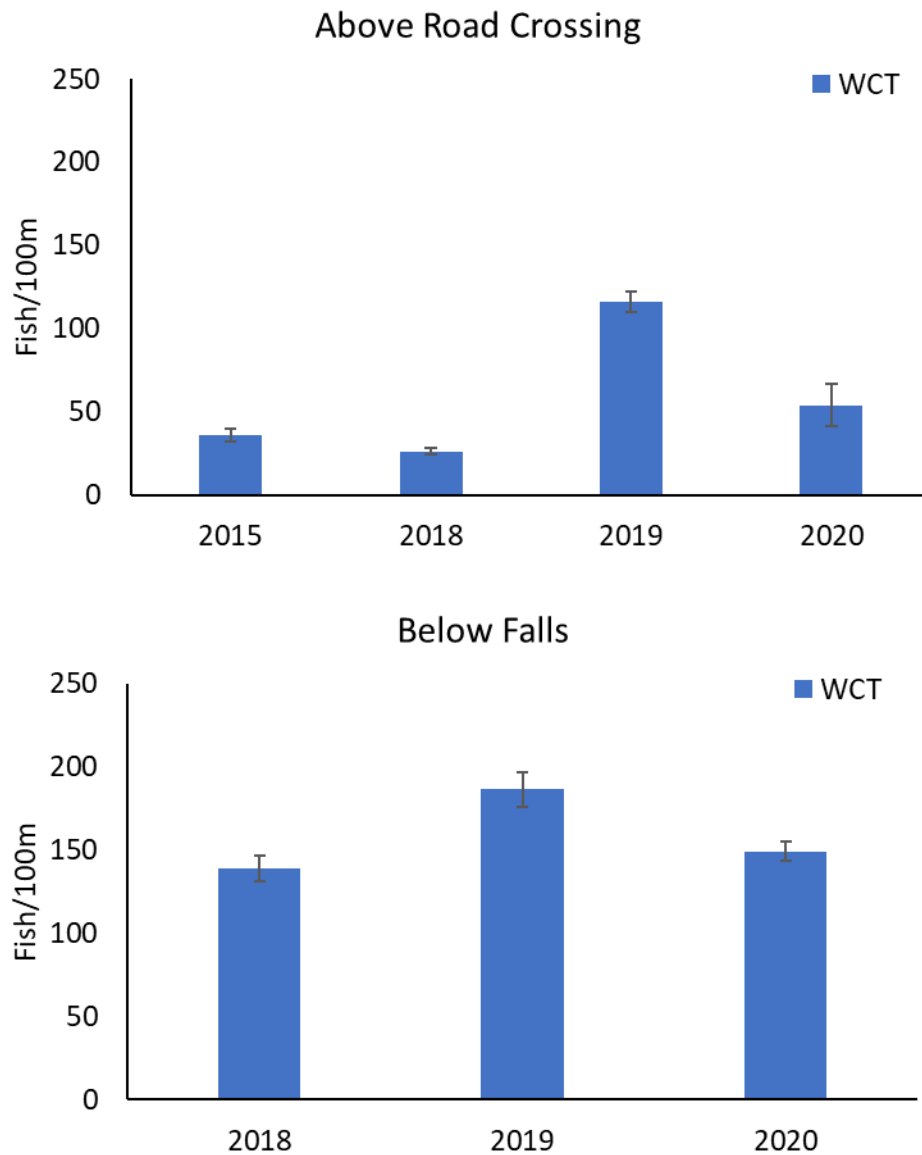


Figure X. Westslope cutthroat trout estimates for two sections of O'Neill Creek. These two sections are on the Spotted Dog WMA.

Little Blackfoot River

Methods and results

Six sections of the Little Blackfoot River are sampled regularly. These sections were sampled semi-annually from 2007-2013 and annually from 2015-2017 and 2019-2020. The two most downstream sections are subject to mark-recapture trout population estimates. Prior to 2019 the mark-recapture estimates were done using backpack electrofishers. In 2019 we switched to using a barge-mounted electrofishing unit that has more power than the backpacks. This increase in power allowed us to effectively capture fish in the deep pools present in these sections. From 2014 to 2019, the four upstream sections were sampled using two backpack units and depletion population estimates were generated. The Above HWY 12 was converted to a mark-recapture method in 2020 and we shifted from backpack to barge electrofishing for that section.

At the FAS section, the average LL estimate from 2007-2020 was 756 fish/km (Figure X). This section also contains a few westslope cutthroat trout, but WCT estimates could only be generated in 2009, 2017, and 2020 (range 4-10 WCT/km).

At the North Trout Creek section, the average brown trout estimate across all years was 547 fish/km. Westslope cutthroat trout estimates could be generated for this section every year but 2015 and average 37 fish/km. It is common for WCT numbers to spike in the Little Blackfoot River in years following high flow years (Jason Lindstrom, pers. communication). Brown trout estimates for this section since 2015 have been lower than all estimates from 2007-2013. It was noted in 2015 that drastic changes in habitat, caused by high flows and incision, had taken place and it is likely that these changes have reduced the carrying capacity for brown trout in this reach of river (Cook et al. 2015).

At the sampling section above the HWY 12 bridge, the 2020 LL estimate was 34 fish/100 m and the WCT estimate was 23 fish/100 m. The 2020 estimate was conducted with a barge-mounted electrofisher and was calculated for fish > 150 mm. Past estimates for this section were done with backpack electrofishing and estimates for fish > 75 mm were calculated. Thus, the 2020 estimate should not be directly compared to past surveys. Mountain whitefish estimates were conducted at the HWY 12 section and sections upstream in the past, but MWF estimates were not conducted in 2019 or 2020.

At the Sunshine Camp section, the average WCT estimate was 10 fish/100m and the LL estimate was 12 fish/100 m. Enough brook trout were captured to produce estimates in 2016 and 2017 and averaged 4 fish/100 m over this time.

At the Ontario Creek section, westslope cutthroat trout tend to outnumber brown trout. The average WCT estimate from 2014-2020 was 43 fish/100 m and the average LL estimate was 29 fish/100 m. Mountain whitefish estimates were conducted in 2014-2015, but not 2017-2020 at the Ontario Creek section.

At the Kading Campground section, westslope cutthroat trout are the dominant trout species, averaging 25 fish/100 m over the last 7 years. Brown trout estimates for the same time period have an average of 8 fish/100 m. Brook trout averaged 21 fish/100 m.

Discussion

The North Trout Creek section has undergone significant changes in habitat since standard sampling started in 2007. Over this time, this section of the Little Blackfoot has downcut, causing a side channel, which used to contain many trout, to dry up. Prior to 2015, the North Trout Creek section had brown trout numbers that were similar to the FAS section. Also, the brown trout populations in these sections used to go up and down in synchrony (Figure X). Since 2015 the brown trout population in the North Trout Creek section is significantly lower than it used to be. On average, estimates since 2015 are only 42% of what they were prior to 2015. The habitat in this section continues to change from year to year. For example, the large woods debris that is prevalent in the North Trout Creek section is rearranged during high flows. Although the brown trout population is down in this section, we did document an increase in WCT number in this section in 2019 and 2020. High flows in 2018 likely increased WCT recruitment to this area of the Little Blackfoot River (Jason Lindstrom, pers. communication).

Other than the North Trout Creek section, trout populations in the Little Blackfoot River have been relatively consistent over time. Population surveys above HWY 12, at the Sunshine Camp, below Ontario Creek, and above Kading Campground do not indicate that there have been large changes in trout abundance or species composition in the last six years.

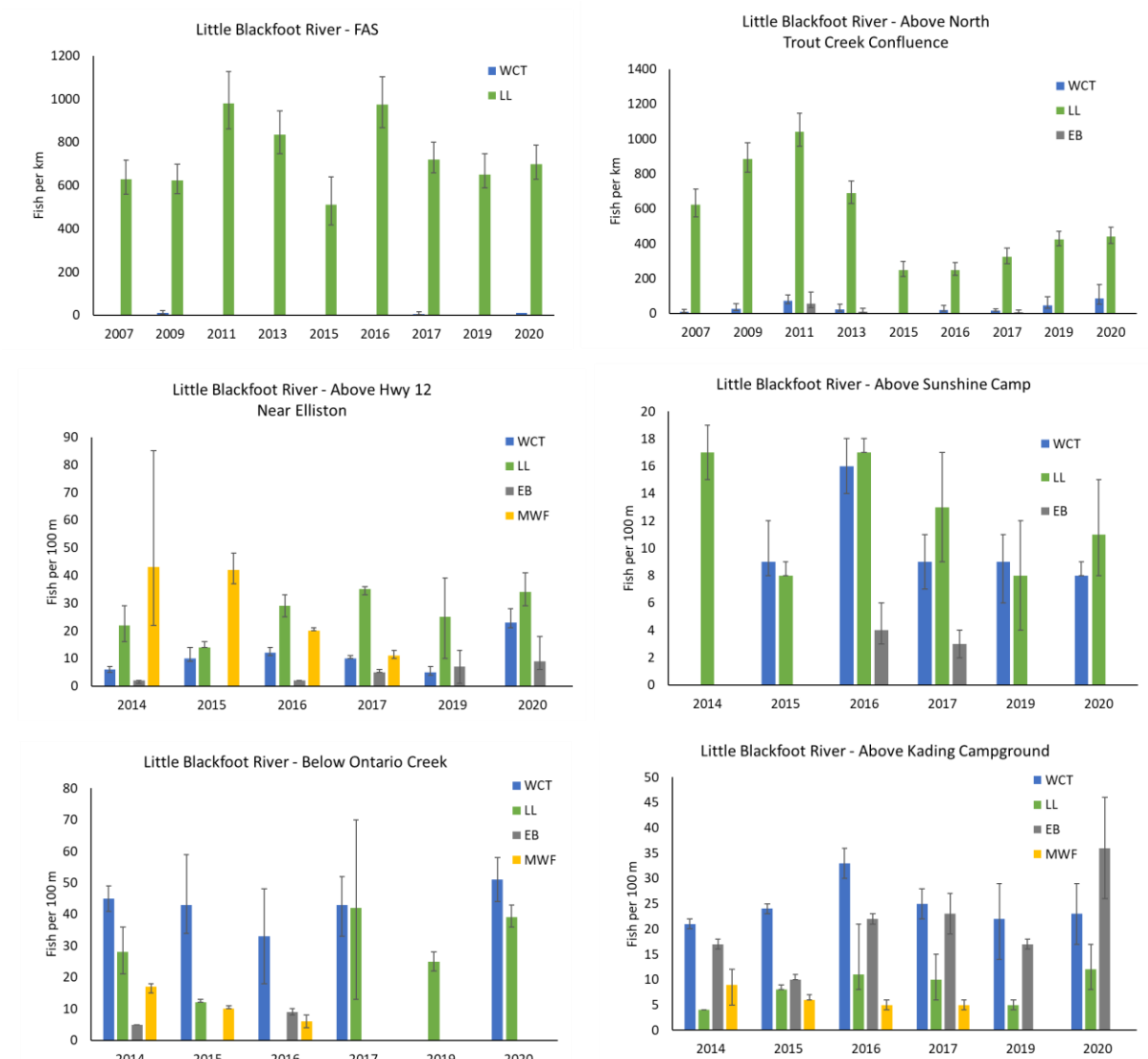


Figure 12. Fish population estimates for six sections of the Little Blackfoot River. Note that estimates for the FAS and North Trout Creek sections are mark/recapture estimates and are in fish/km and are for fish ≥ 150 mm. Estimates for the other four sections are depletion estimates, are in fish per 100 m, and are for fish ≥ 75 mm. Error bars are 95% CI.

Spotted Dog Creek

Four sections of Spotted Dog Creek were sampled in 2020. These were sections in the upper reaches of the creek within the WMA and USFS land. The lower two sections were sampled to get baseline fish data prior to upcoming restoration projects. The upper two sections are outside of the project area and data from these upper sections were collected to provide control or reference data.

At the most downstream section, the brook trout estimate was 60 fish/100 m (95% CI = 54-66) and the westslope cutthroat trout estimate was 22 fish/100m (21-23). This section is in an area that will undergo channel realignment in the future. The next section upstream is in an area of the stream that will be enhanced with beaver dam analogues (BDAs). The EB estimate in this section was 83 fish/100 m (74-92) and the WCT estimate was 39 fish/100 m (30-48). Slimy sculpin were also captured in the BDA Section. Of the two sections that are outside the area of future restoration projects, the Below Forest Service Section is the most downstream. The EB estimate at this section was 25 fish/100m (19-31) and the WCT estimate was 87 fish/100m (78-96). Slimy sculpin were also captured. At the section above the North Fork of Spotted Dog Creek, the EB estimate was 9 fish/100 m (8-10) and the WCT estimate was 37 fish/100 m (22-52).

FWP will continue to monitor these sections on upper Spotted Dog Creek for changes in response to restoration activities. Specifically, we will be looking for changes in trout abundance and species composition.

Table 5. Electrofishing data collected from Spotted Dog in 2020. Population estimates (95% CI) are for trout greater than 75 mm (~ 3") in total length.

Section Name	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)	Estimate per 100m
Restoration Phase 2	EB	74	77	45-216	102	20	60 (54-66)
	WCT	22	23	77-187	126	25	22 (21-23)
Upper BDA	EB	80	69	47-224	113	19	83 (74-92)
	SL COT	1	1	67			
	WCT	35	30	77-198	118	21	39 (30-48)
Below Forest Service	EB	28	22	46-216	144	45	25 (19-31)
	SL COT	7	6	45-109			
	WCT	91	72	32-215	107	17	87 (78-96)
Above N. Fork Spotted Dog Ck.	EB	10	16	73-171	99	18	9 (8-10)
	WCT	53	84	28-153	83	13	37 (22-52)

Trout Creek

Three sections of Trout Creek were sampled in 2020. These three sections were also sampled in 2018 and 2019. The most downstream section is on state trust land and the other two sections are on the Spotted Dog WMA. The most downstream section is at river mile 4.5. Low numbers of both WCT and EB were captured in 2020. Only four WCT and two EB were caught, so no population estimates could be generated. The RM 4.5 section has had low trout densities in the past (Figure X.), but densities in 2020 were especially low. At the middle section (RM 7.0), the EB estimate was 16 fish/100 m (95% CI = 15-17) and the WCT estimate was 42 fish/100 m (37-47). At the most upstream section (RM 9.4), the WCT estimate was 56 fish/100 m (53-59). Brook trout have not been detected at the most upstream section on Trout Creek.

Compared to other tributaries in the Upper Clark Fork River Basin, brook trout are rare in Trout Creek. Other species present in Trout Creek include longnose suckers and one brown trout was captured at RM 4.5 in 2018. Westslope cutthroat trout are by far the dominant species in this small tributary to the Little Blackfoot River.

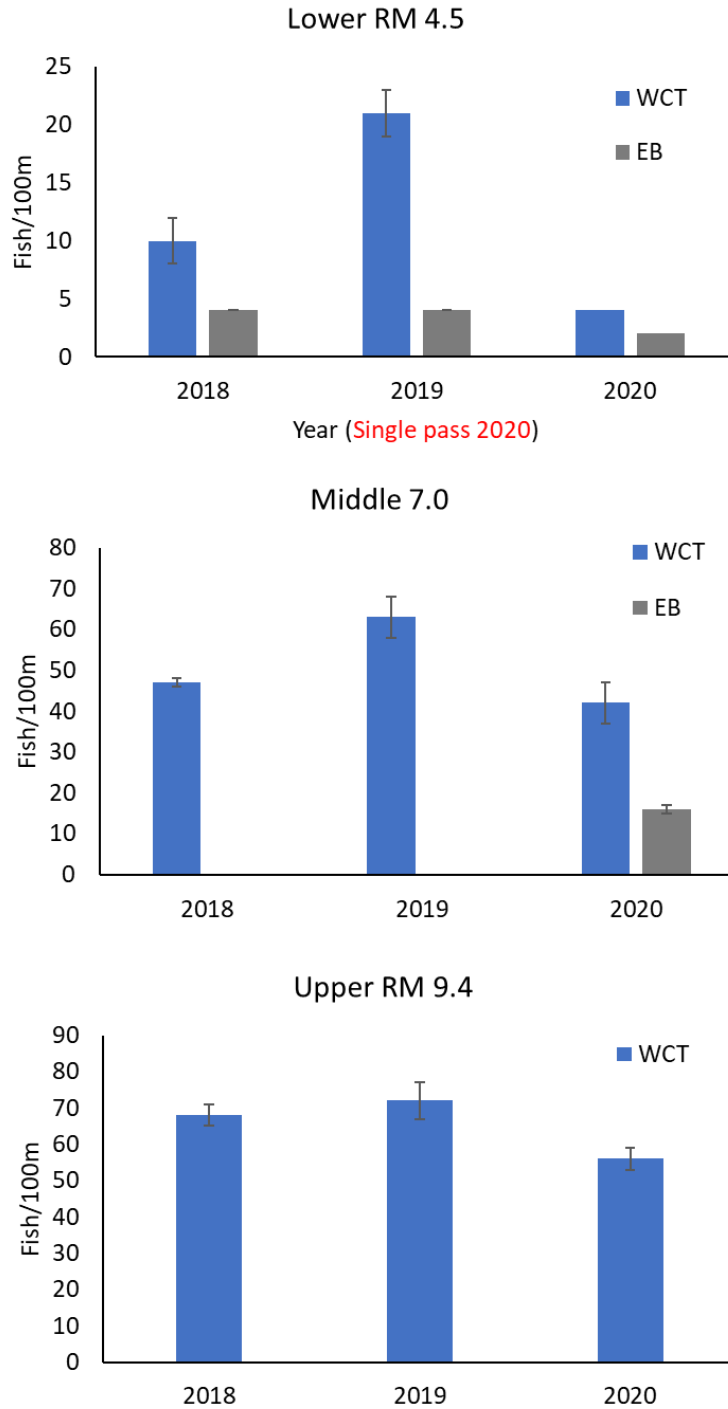


Figure X. Trout Creek population estimates for westslope cutthroat trout and brook trout ≥ 75 mm, 2018-2020. Not enough trout were captured at RM 4.5 in 2020 to generate population estimates, so number of fish caught in one electrofishing pass is presented for that year. Brook trout have been captured at the Middle Section every year, but a population estimate could only be generated for this species in 2020. Brook trout have not been captured at the RM 9.4 Section.

Boulder Creek

Six sections of Boulder Creek were sampled in 2020. Four of these sections were established monitoring sections that have been surveyed periodically since 2014-2016, depending on the section. The other two sections are new monitoring sites established in 2020 to evaluate areas of Boulder Creek that underwent restoration projects completed in 2017. Although baseline fish surveys were not done prior to restoration, we can still compare fish population data from the restoration sections to that of other parts of Boulder Creek.

The most downstream section (River Mile 0.4) has been sampled five times since 2014. The westslope cutthroat trout population estimate in 2020 was 21 fish/100 m (20-22), which is the highest WCT we have recorded at this section (Figure X). The brown trout estimate was 32 fish/100 m (28-36) in 2020 at the RM 0.4 Section. Three bull trout and nine slimy sculpin were also captured in 2020 at RM 0.4. At the RM 2.0 Section, the LL estimate was 17 fish/100 m (16-17) and the WCT estimate was 42 fish/100 m (34-50) in 2020. One BULL, 5 mountain whitefish, and 12 SL COT were also captured. At the restored section at river mile 3.7, which is on the Lundgren property, the WCT estimate was 128 fish/100 m (104-152), the LL estimate was 29 fish/100 m (16-42), and the BULL estimate was 8 fish/100 m (8-8). Eleven SL COT were also captured. At the restored section at river mile 5.0, which is on the Olsen property, the WCT estimate was 43 fish/100 m (36-50), the LL estimate was 7 fish/100 m (5-9), and the BULL estimate was 16 fish/100 m (8-24). Three brook trout, one EBxBull hybrid, and 17 SL COT were also captured. At the RM 6.5 (Princeton Bridge) Section, the WCT estimate was 41 fish/100 m (20-61) and the BULL estimate was 70 fish/100 m (44-95). One EBxBull hybrid and one LL were also captured. At the Copper Lake Trailhead Section (RM 8.2), the WCT estimate was 17 fish/100 m (13-21). Six BULL were also captured.

The restored section of Boulder Creek at river mile 3.7 contains a robust population of westslope cutthroat trout. Densities of WCT were significantly higher in this section than any other section of Boulder Creek sampled in 2020. There was also a diversity of length classes of WCT ranging from 70 mm to 377 mm fish. There were also a wide range of brown trout length classes in this section (49-393 mm). The restored section at RM 5.0 had relatively high numbers of BULL trout, with the number of BULL captured (14) second only to the Princeton Bridge Section (50 BULL captured). In 2020, the Princeton Bridge Section had one of the highest BULL densities of any area in Upper Clark Fork River Basin, and contained a variety of age classes, ranging from young of year to adults.

Table 6. Electrofishing data collected from Boulder Creek in 2020. Population estimates (95% CI) are for trout greater than 75 mm (~ 3”) in total length.

Section Name/RM	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)	Estimate per 100m (95% CI)
USGS Gauge RM 0.4	BULL	3	5	180-291	230	102	
	LL	34	51	47-366	186	142	32 (28-36)
	SL COT	9	13	47-92	70		
	WCT	21	31	134-335	239	108	21 (20-22)
RM 2.0	BULL	1	1	186	186	56	
	LL	19	25	52-410	164	94	17 (16-18)
	MWF	5	7	304-434	376	597	
	SL COT	12	16	37-96	67		
	WCT	38	51	77-282	148	54	42 (34-50)
Lundgren Restoration	BULL	7	5	121-235	150	35	8 (8-8)
	EB	7	5	48-124	65	7	
	LL	32	21	49-393	122	82	29 (16-42)
	SL COT	11	7	45-76	61	8	
	WCT	95	63	70-377	127	47	128 (104-152)
Olson Restoration	BULL	14	17	126-268	174	52	16 (8-24)
	EB	3	4	144-165	153	33	
	EBxBULL	1	1	266	266	174	
	LL	7	8	91-371	175	120	7 (5-9)
	SL COT	17	20	52-105	79	15	
	WCT	41	49	34-368	156	69	43 (36-50)
RM 6.5 Princeton Bridge	BULL	50	64	58-313	165	53	70 (44-95)
	EBXBULL	1	1	298	298	261	
	LL	1	1	255	255	154	
	WCT	27	34	79-278	165	65	41 (20-61)
Copper Lakes Trailhead	BULL	6	24	45-270	172	113	
	WCT	19	76	63-315	175	97	17 (13-21)

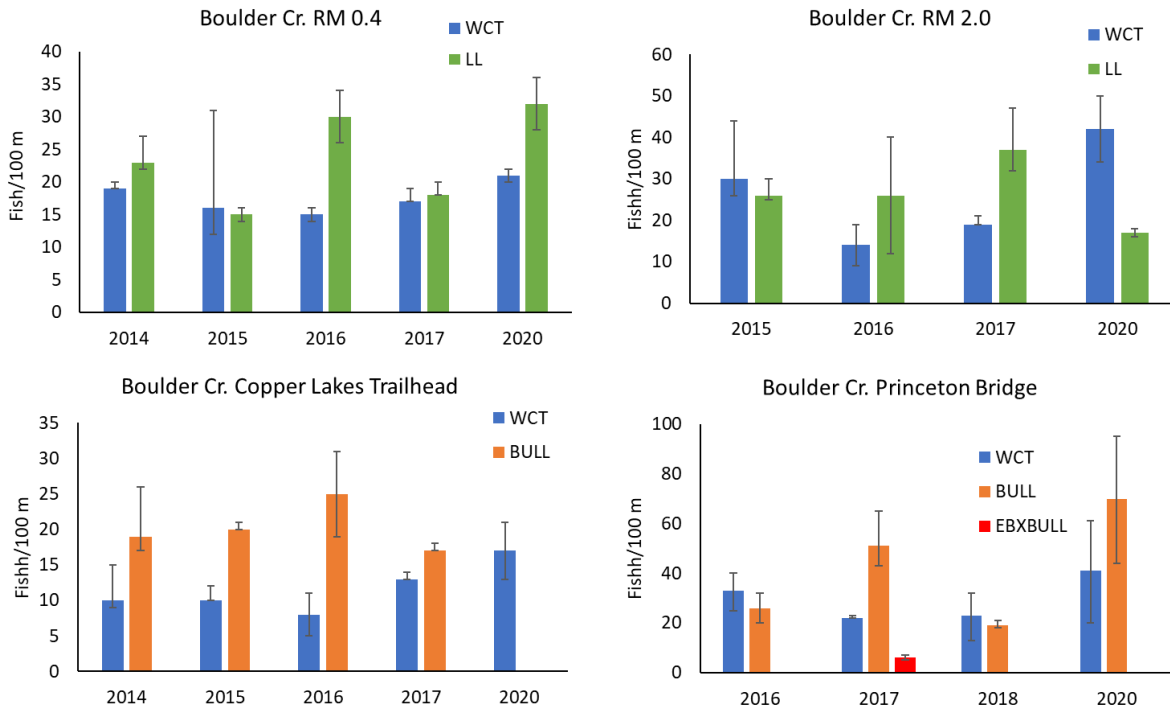


Figure 13. Boulder Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI. Population estimates for the two restored sections of Boulder Creek are not presented because they were only sampled in 2020. Not enough BULL were captured at the Copper Lakes Trailhead Section in 2020 to generate a population estimate.

Harvey Creek

Methods and results

Six sections of Harvey Creek were sampled in 2020. The four downstream sections (at river miles 0.6, 1.2, 1.6, and 2.3) are on private property that has been the focus of numerous restoration projects including a fish screen, fencing, and instream flow work. The two upstream sections (Below 8 Mile and above FS Road) are on Forest Service. All sections were sampled using backpack electrofishers and depletion estimates were calculated for trout.

At the River Mile 0.6 section, the 2020 WCT estimate was 37 fish/100 m (95% CI = 28-44). The average WCT estimate for this section is 34 fish/100 m. One BULL that was 58 mm was captured in this section in 2020. Bull trout were first captured in this section in 2019. At the River Mile 1.2 section, the WCT estimate was 66 fish/100 m (52-80) and the BULL estimate was 6 fish/100 m (4-8). Like the RM 0.6 section, BULL were first detected in the RM 1.2 section in 2019. Bull trout captured in 2020 at RM 1.2 ranged from 55-190 mm in length. At the River Mile 1.6 section, the WCT estimate was 64 fish/100 m (57-71) and the BULL estimate was 14 fish/100 m (9-19). Bull trout captured in the RM 1.6 section ranged from 103-345 mm in length. One BULL was captured in both 2014 and 2017 at the RM 1.6 section. In 2019, 18 BULL were captured, all of which were young of year or one year old fish (average length 103 mm). At the River Mile 2.3 sections, the WCT estimate was 15 (14-16) and the BULL estimate was 6 (5-7). Although BULL have been captured at this section in previous years, 2020 was the first year a population estimate could be generated.

At the Below 8 Mile section, the WCT estimate was 53 fish/100 m (42-64) and the BULL estimate was 30 fish/100 m (23-37). The 2020 WCT estimate was the lowest we have calculated at this section, whereas the BULL estimate is the highest ever recorded for this section. At the Above FS Road section, the WCT estimate was 18 fish/100 m (16-20) and the BULL estimate was 15 fish/100 m (14-16). Both trout estimates were on the low end for WCT and BULL estimates at the FS Road Section.

Discussion

In recent years, bull trout have expanded in both abundance and distribution in lower Harvey Creek. In 2019, the detection of bull trout at the River Mile 0.6 section was the most downstream that BULL had been documented in Harvey Creek. One young-of-year bull trout was also captured at this location in 2020. At the next section upstream at river mile 1.2, BULL also had not been detected until 2019. Seven BULL were captured in the RM 1.2 section in 2019 and six were captured in 2020. At the RM 1.6 section, 18 juveniles were captured in 2019, which was

the most BULL ever captured the lower reaches of Harvey Creek. Although BULL densities remain modest in lower Harvey Creek, recent increases in numbers and distribution hopefully signal that the species can maintain a population in the lower reaches. It is also encouraging that we have been finding multiple age classes suggesting that reproduction is occurring. The colonization of BULL to lower Harvey Creek may have been helped by the high flows of 2018 and/or restoration actions. The RM 1.6 section is directly below a fish screen that was installed in 2014. By eliminating entrainment, this fish screen is likely contributing to the establishment of bull trout and improvements in riparian condition and flows may also have effects. The RM 1.6 section was sampled in 2014 prior to the fish screen being operational. The 2014 population estimate for WCT was 34 fish/100 m (33-37). When the RM 1.6 section was sampled in 2015 after the screen was functioning, the WCT estimate increased to 121 fish/100 m (114-130). This increase was due to recruitment of young WCT (~100 mm) WCT to this part of Harvey Creek (Figure 13). Since 2015 WCT estimates have been > 60 fish/100 m at the RM 1.6 section.

Harvey Creek is a native fish stronghold in the UCFRB. Significant restoration actions in the lower reaches of Harvey Creek have the potential to enhance the resilience of the isolated WCT and BULL population. We may already be seeing benefits to the BULL population and a localized benefit from the fish screen to the WCT population. Monitoring the direct benefits of the fish screen, such as enumerating the number of fish bypassed by the screen, could help further our understanding of the benefits of screening irrigation ditches. Lessons learned in Harvey Creek about this restoration strategy could also be applied to other priority tributaries in the UCFRB.

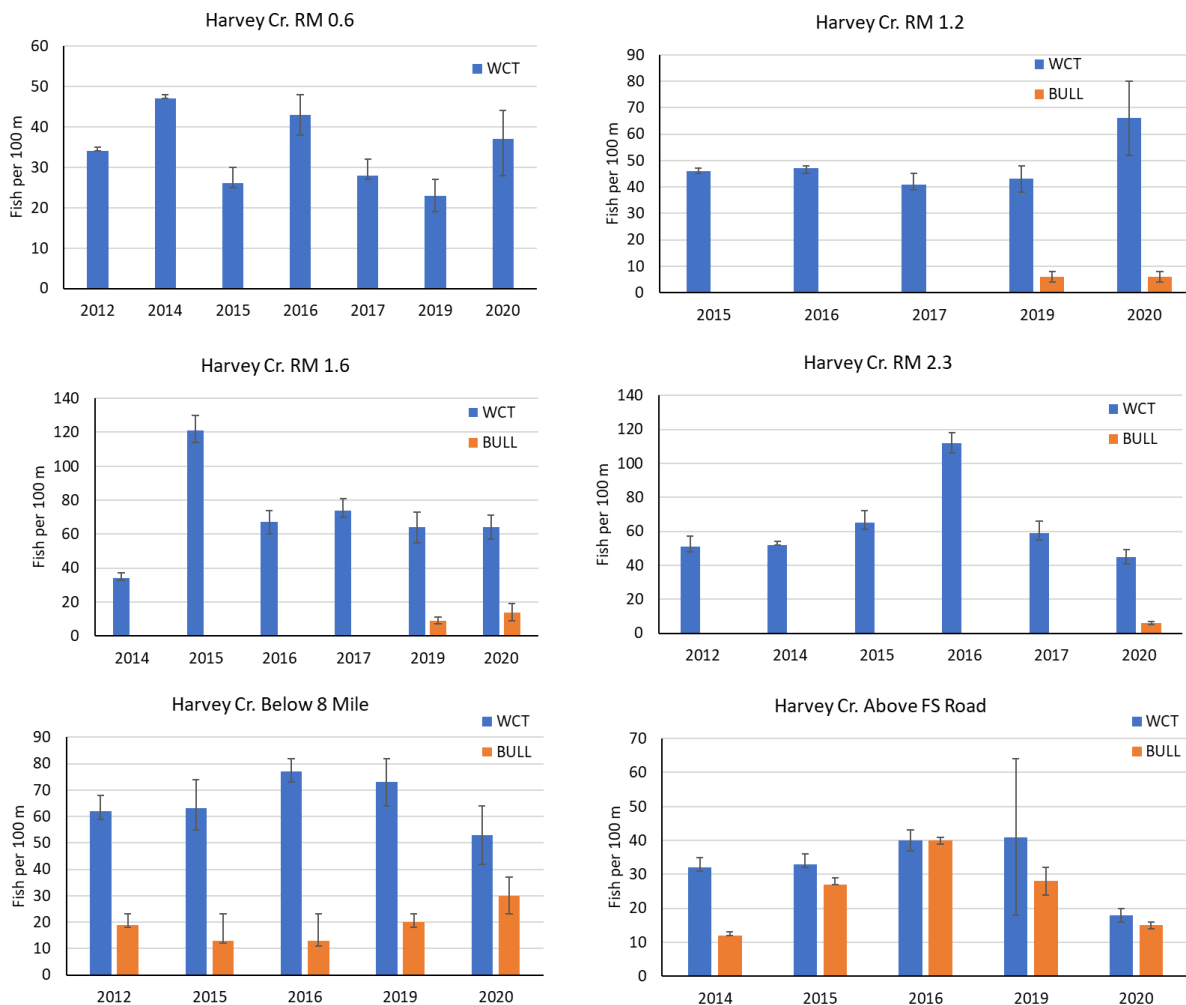


Figure 13. Harvey Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI.

Table 7. Electrofishing data from Harvey Creek, 2020.

Section Name/RM	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)	Estimate per 100 m
RM 0.6	BULL	1	<1	58	58		
	WCT	35	99	35-336	139	54	37 (28-44)
RM 1.2	BULL	6	5	55-190	127	26	6 (4-8)
	WCT	52	40	16-264	124	36	66 (52-80)
	SL COT	71	55	42-96	69		
RM 1.6	BULL	13	9	106-345	157	72	14 (9-19)
	WCT	61	41	37-346	164	74	64 (57-71)
	SL COT	74	50	42-95	69		
RM 2.3	BULL	9	17	52-272	148	51	6 (5-7)
	WCT	44	83	75-351	159	73	45 (41-49)
Below 8 Mile	BULL	28	33	45-214	121	27	30 (23-37)
	WCT	57	67	60-299	123	39	53 (42-64)
Above FS Road	BULL	17	38	42-245	140	36	15 (14-16)
	WCT	28	62	62-267	137	49	18 (16-20)

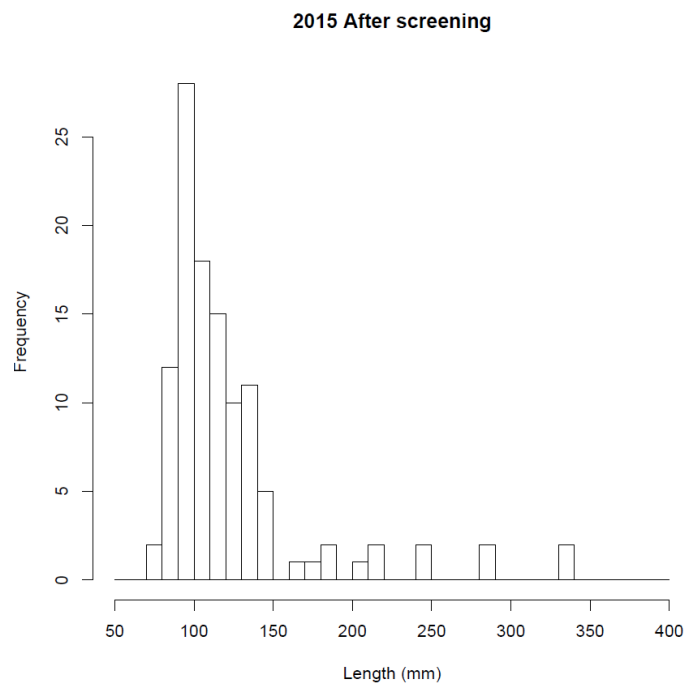
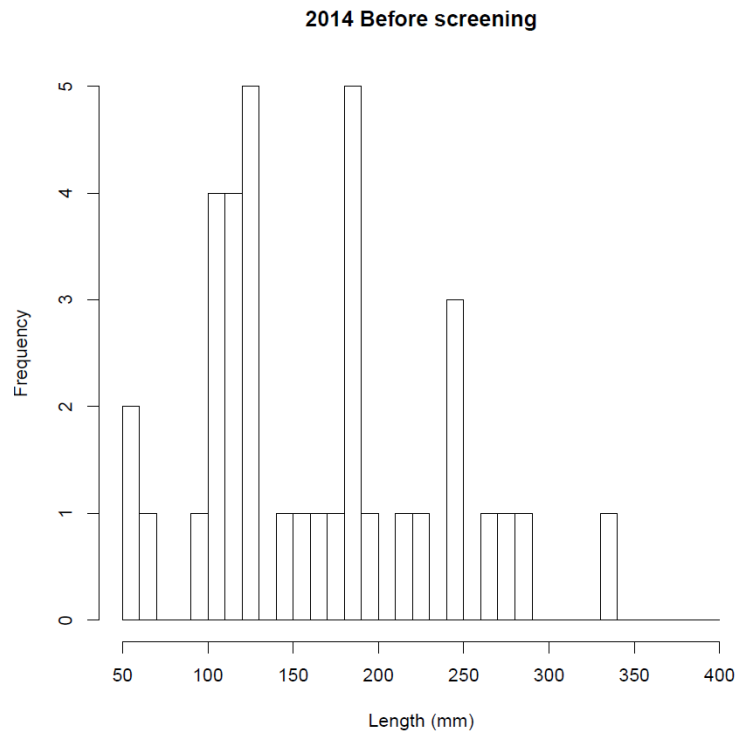


Figure 14. Length-frequency histograms for Westslope cutthroat trout captured in the River Mile 1.6 section of Harvey Creek before and after a fish screen was installed directly upstream.

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