Fisheries Monitoring in the Upper Clark Fork River Basin
2019 Report



Prepared By:

Nathan Cook & Tracy Elam

Montana Fish, Wildlife, and Parks

Region 2, Fisheries Division

Table of Contents

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 under way 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 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 semi-annually, which was the sampling schedule prior to 2015.

Clark Fork River Mainstem

Population surveys

Trout population estimates were conducted in spring 2019 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, two additional sampling sections were sampled in spring. These sections are Perkins to Galen and Galen to Racetrack. These two sections were scheduled to be sampled in 2020, but were sampled in 2019 in response to the low fish numbers observed in the annual sections. Essentially sampling was expanded to verify that trout numbers were down throughout the upper river and fish had not merely moved into different reaches.

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 Park's Fisheries Information System. Estimates were calculated for trout species that had a minimum of 4 marked fish that were recaptured (B. Liermann, Montana, Fish, Wildlife, and Parks, personal communication, 2014). When comparing estimates between years, estimates with non-overlapping 95% confidence intervals were considered significantly different.

The brown trout population estimate at the pH Shack section in 2019 was 51 fish/km, the lowest estimate ever recorded for this section (Table 1, Figure 2). The 2019 estimate is less than half of what is was in 2018 (104 fish/km). The highest estimate during the last 11 years occurred in 2013 when the brown trout population was at 1167 fish/km. The brown trout population at pH Shack declined by 85% between 2013 to 2015 and has since remained relatively low. At the pH-Shack-to-Perkins Lane section, the 2019 brown trout estimate was 8 fish/km, well below the average of 115 fish/km. Brown trout numbers were also at a record low at the Sager Lane section in 2019 at 59 fish/km. At the Williams-Tavenner section, the 2019 brown trout estimate was 145 fish/km, the lowest estimate since 2012. Brown Trout numbers at Phosphate were 173 fish/km in 2019, which is not significantly lower statistically than the section average of 210 fish/km. The 2019 brown trout estimate at the Morse Ranch section was 75 fish/km, which was not significantly below the 2009-2019 average of 86 brown trout/km. In addition, the combined *Oncorhynchus* (WCT, RB, and hybrids) estimate at Morse Ranch was 9 fish/km. At the Bearmouth section, the 2019 brown rout estimate was 21 fish/km, which is significantly lower than the average estimate of 31 fish/km. The 2019 *Oncorhynchus* estimate at Bearmouth was 22 fish/km which was similar to the long-term average of 24 fish/km.

Sampling at the Perkins to Galen and Galen to Racetrack sections provided further evidence of the low brown trout numbers in the Upper Clark Fork River in 2019. The brown trout population estimate the Perkins to Galen section was 16 fish/km. The average population estimate over 1987, 2009, and 2015 was 184 fish/km (SD = 166). This section is located in an unremediated part of the Clark Fork River. In the Galen to Racetrack section, in which remediation was completed in 2016, the 2019 brown trout estimate was 34 fish/km. The average of the three past estimates at this section is 149 fish/km (SD = 53).

Fish Kill

On September 10th, 2019 FWP received a report of dead trout and mountain whitefish in the upper Clark Fork River near Galen. The fish were found between Perkins Lane and Galen Bridge. This is an area with actively eroding slicken areas that are sloughing tailings materials into the river. On September 12th, we did a visual survey of 1.5 miles of the river downstream of Perkins Lane. During this survey, 32 dead fish were found including 8 brown trout, 22 whitefish, and 2 suckers. Dead fiish were a variety of sizes ranging from 125 mm to 350 mm (Photo 1). Schools of small fish (likely redside shiners) were observed swimming in the area. A one mile reach above Perkins Lane was surveyed, but no dead fish were observed. A one mile reach downstream of Gemback Bridge was also surveyed and no dead fish were found.

The fish kill was reported on a Saturday, the day after locally intense thunderstorms resulted in an inch or more of rain in the area. Similarly intense storms occurred on Sunday, which is the day before the mortality survey took place. During the mortality survey, it was clear that runoff and erosion of slickens in the area had occurred. Freshly deposited fine sediment was present in depositional areas and on aquatic vegetation. This sediment had an orange color, similar to the iron rich portions of some slickens. Blue sediments, colored by copper, could be found in the river at the foot of some slickens (Photo 2).

Berms were constructed around slickens in the late 1980s with the goal of keeping contaminants out of the river. The berms functioned well for decades, as no fish kills related to metals toxicity were documented for 25+ years. Prior to construction of these berms, fish kills in the UCFR were common, particularly after big rainstorms. These berms have degraded in the past 3-4 years (Clark Fork Coalition, 2019). When visiting the area, it was clear that at least one of the berms was blown out by recent rains (Photo 3).

It is unknown how many fish were killed during this event and how far downstream it may have caused mortalities. The fact that all dead fish were found within a 1.5 mile long area near the most actively eroding slickens on the river suggests that the acute effects of the event may have been localized. However, the exact spatial extent of the fish kill is unknown. We also cannot determine how may fish may have died due to more long term chronic effects. It is also possible

that similar events have taken place in the recent past and are a likely cause of crash in the UCFR trout fishery.

Discussion

The trout population in the upper reaches of the Clark Fork River are at historic lows. Spring population estimates have been conducted at the pH Shack section since 1973 and the 2019 brown trout estimate was the lowest ever recorded (Figure 3). Population estimates at the other sampling sections upstream of Deer Lodge were also the lowest ever recorded. At Williams-Tavenner the 2019 brown trout estimate was below average, but was higher than estimates during 2009-2011. Overall, brown trout numbers are much closer to average downstream of Deer Lodge compared to upstream of Deer Lodge. 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 (Cook et al. 2017). 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, recruitment in 2018 and 2019 was much lower than would be predicted by the flow model.

The cause for the crash in the brown trout population upstream of Deer Lodge is not fully understood. However, the fact that these reaches of the Clark Fork river have the most extensive slickens of anywhere in the river and many of the slickens have recently began to erode directly into the river must be having deleterious effects on the population. The documented fish kill confirmed the lethality of slicken material, not only to trout, but also to mountain whitefish and suckers. Given that removal of some slickens will not happen for decades, measures are needed to keep contaminated material out of Clark Fork River before remediation has a chance to clean them up.

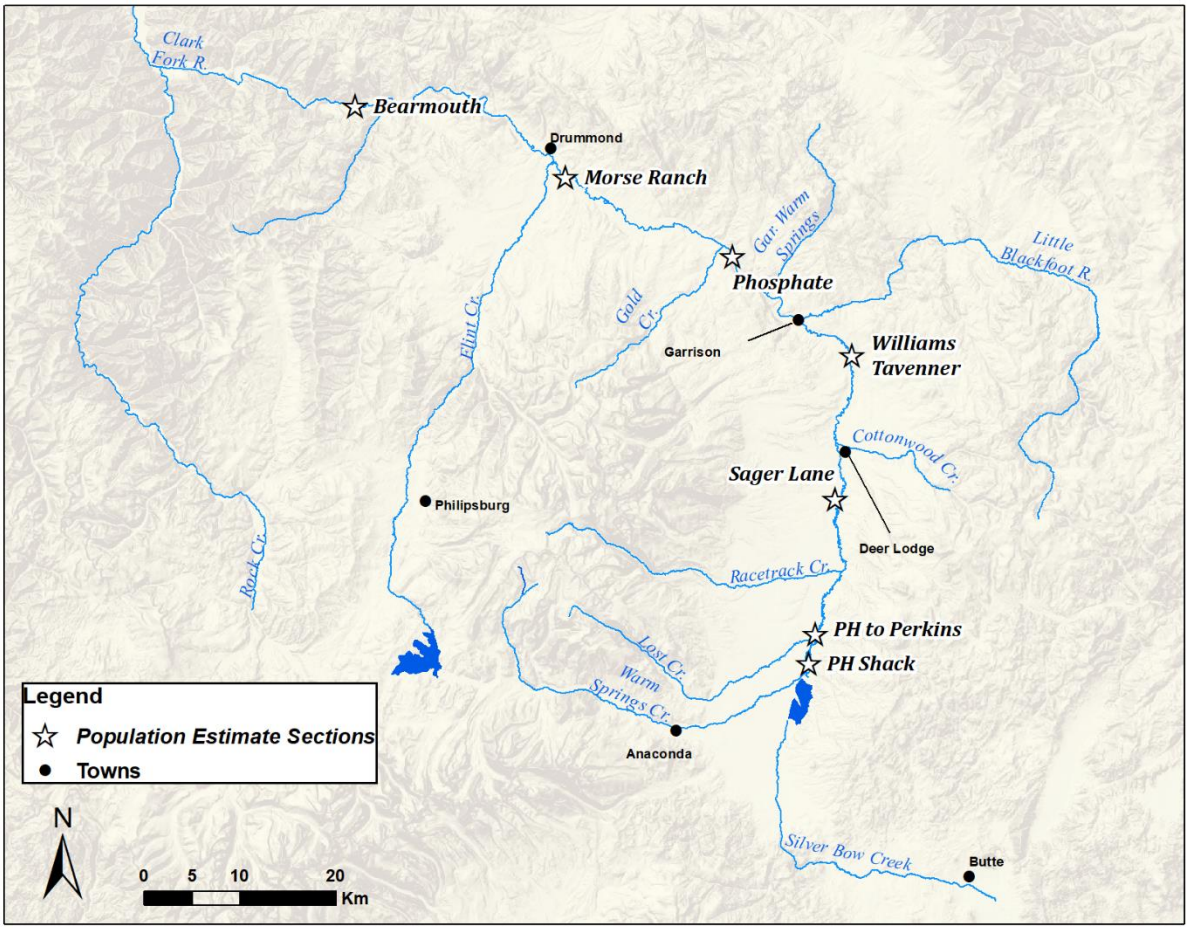

Figure 1. Map of annual fish population estimate sections in the Upper Clark Fork River.

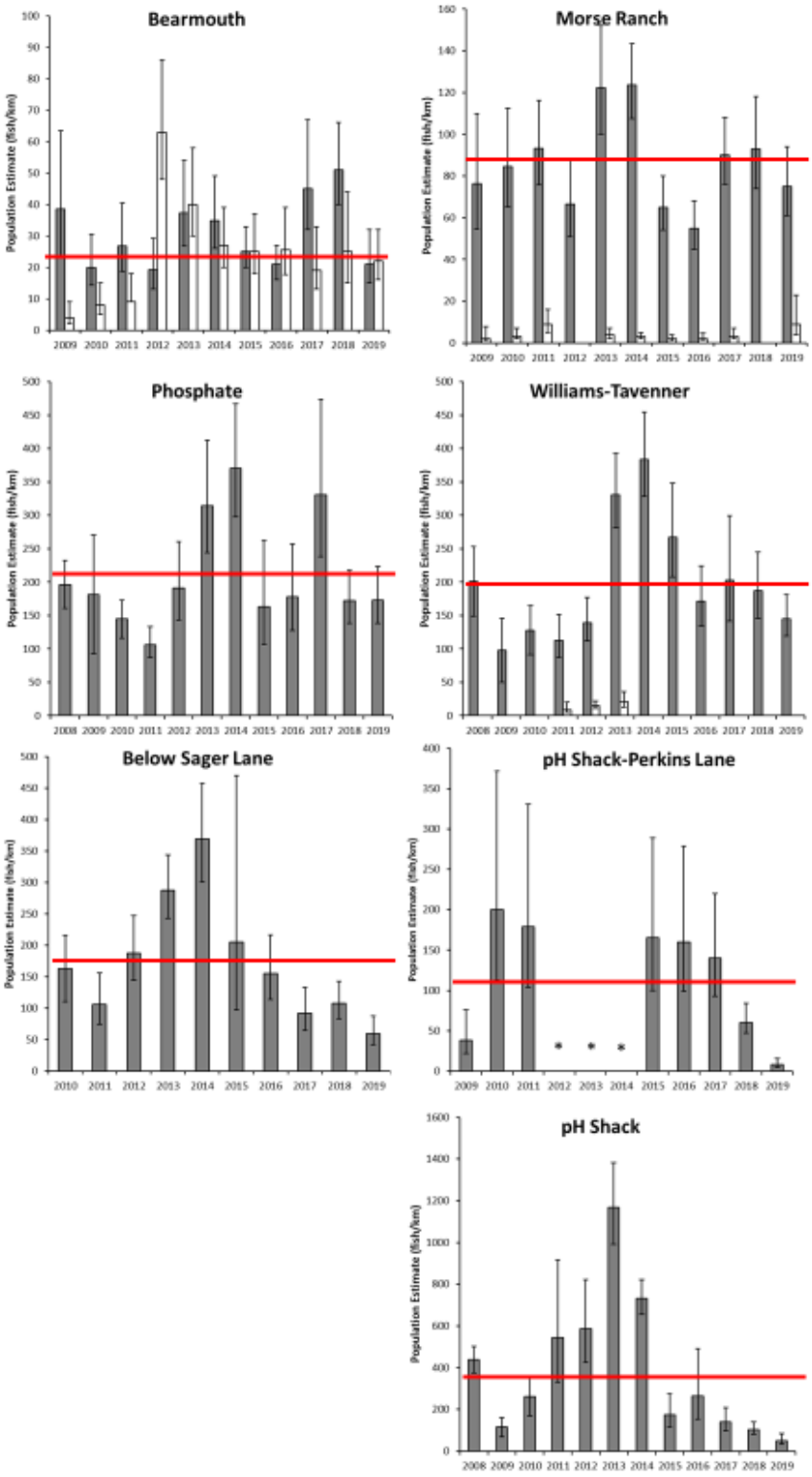

Figure 2. Clark Fork River brown trout (grey bars) and *Oncorhynchus sp.* (white bars) population estimates from 2008-2019 by sample section. Please note that axis values are not the same for every sample reach. The red line depicts the average brown trout population estimate for the section.

Table 1. Electrofishing data collected in Spring 2019 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. Species abbreviations: LL = Brown Trout, ONC = combined *Oncorhynchus sp*., WCT = Westslope Cutthroat Trout, RB = Rainbow Trout, BULL = Bull Trout, RBXWCT = phenotypic hybrid between Rainbow Trout and Westslope Cutthroat Trout.

Section	Species	Population Estimate (fish/Km)	# Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
Bearmouth	LL	21(15-32)	105	347	181-547	46.9
	ONC	22(16-32)	118			
	RB		88	387	194-485	39.3
	WCT		14	347	375-390	6.3
	RBxWCT		16	350	254-470	7.1
	BULL		1	522		0.4
Morse Ranch	LL	75(61-94)	416	332	175-505	91.6
	ONC	9(4-23)	38			
	WCT		10	304	245-415	2.2
	RB		2	423	422-424	0.4
	RBxWCT		26	285	238-370	5.7
Phosphate	LL	173(138-223)	303	319	98-518	92.1
	WCT		24	317	237-430	7.3
	RBxWCT		2	257	246-268	0.6
Williams Tavenner	LL	145(119-181)	337	346	95-550	94.4
	WCT		14	283	245-325	3.9
	RB		1	457		0.3
	EB		5	235	194-306	1.4
Below Sager Lane	LL	59(42-87)	165	325	95-515	97.1
	EB		1	156		0.6
	WCT		1	290		0.6
	RB		2	381	357-404	1.2
	RBxWCT		1	302		0.6
PH Shack to Perkins Ln.	LL	8(5-16)	20	285	114-504	87.5
	RB		2	514	464-564	8.7
	WCT		1	365		4.3
PH Shack	LL	51(34-84)	74	364	96-505	94.9
	RB		1	515		1.3
	WCT		1	317		1.3
	EB		2	283	281-284	2.6

Table 2. Electrofishing data collected in Spring 2019 from two sampling sections on the Upper Clark Fork River. Population estimates (95% confidence interval) are for trout greater than 175 mm (~ 7") in total length.

section	Species	Population Estimate (fish/Km)	# Fish Handled	Mean Length (mm)	Length Range (mm)	Species Composition (%)
Perkins to Galen	LL	16(7-40)	51	293	120-503	98.1
	WCT		1	260		1.9
Galen to Racetrack	LL	34(21-63)	92	371	115-635	97.9
	WCT		2	311	252-369	2.1

Photo 1. Dead brown trout from a fish kill in the upper Clark Fork River in fall 2019. Photo courtesy of the Clark Fork Coalition.

Photo 2. Blue colored rocks in the Clark Fork river at the foot of an eroding slicken. Photo courtesy of Trout Unlimited.

Photo 3. This is a large slicken that was partially contained by a berm (to the right) until heavy rains and scour from the Clark Fork River caused the berm to fail. You can see a highwater line of debris, indicating that this slicken became a pond during thunderstorms. When the berm failed, highly contaminated water and tailings must have rapidly entered the river.

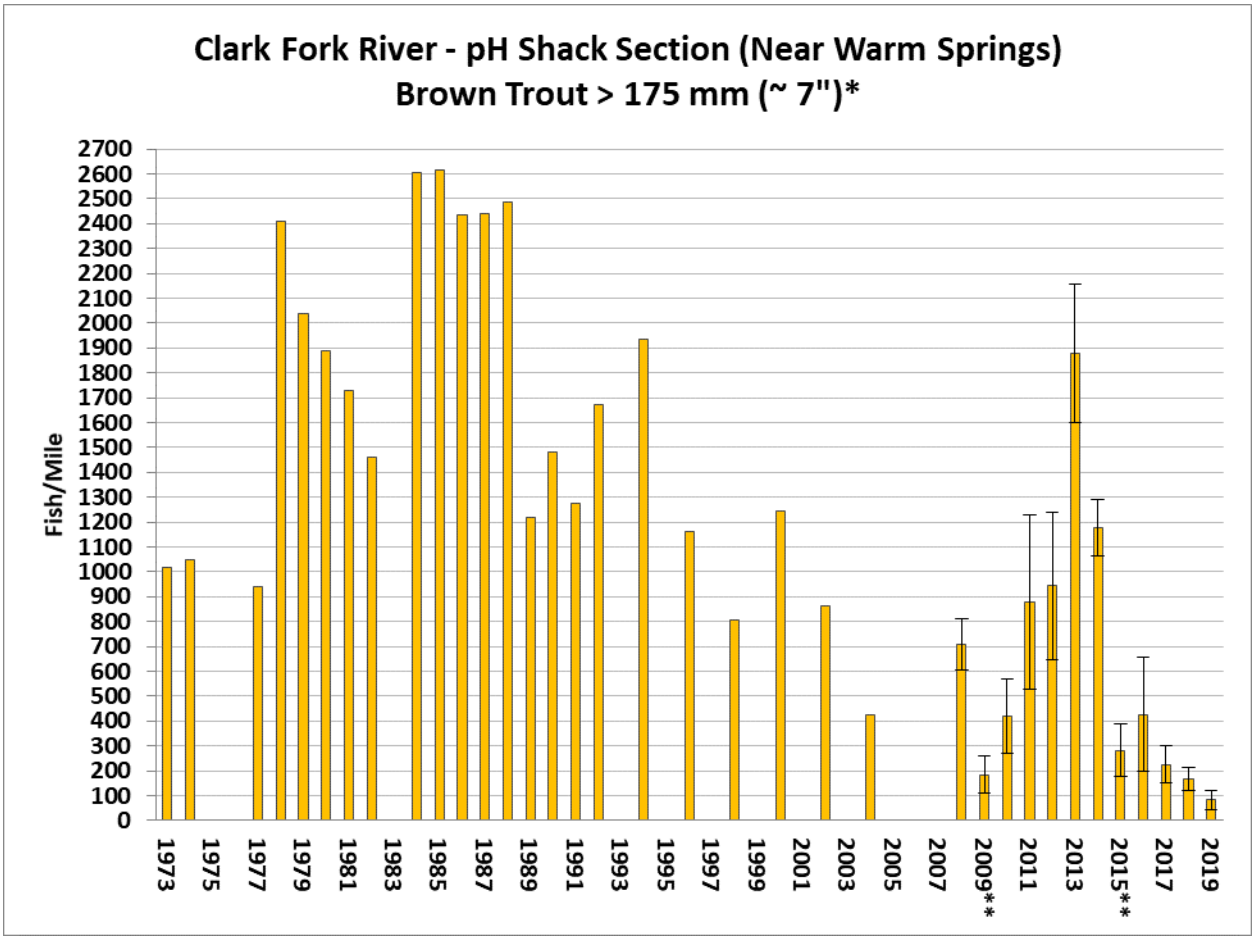

Figure 3. Brown trout population estimates at the pH Shack section of the upper Clark Fork River. Confidence intervals were not available for surveys prior to 2008.

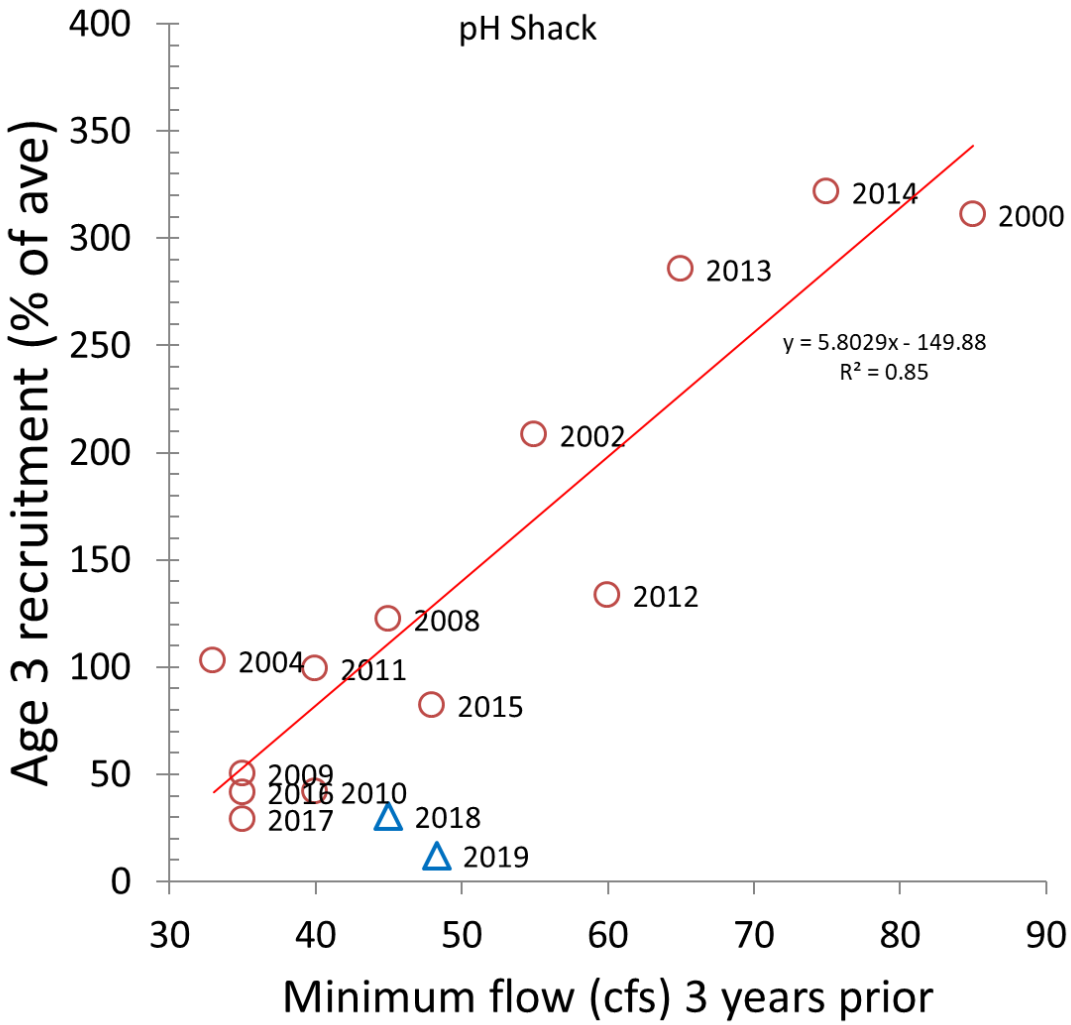

Figure 4. Linear regression of recruitment of age 3 brown trout recruitment versus minimum flow (as measured at the Clark Fork River at Galen USGS gauge) three years prior to sampling. Recruitment was calculated as the number of age three fish captured during population estimates, standardized to the average number from 2008-2019. Data labels are the year fish were sampled. Recruitment data from 2018 and 2019 were not used in the regression, but are included in the chart to show divergence from the model.

Silver Bow Creek

Silver Bow Creek was sampled at seven sections using backpack electrofishing. These sections have been sampled in both summer and fall since 2015. Areas of Silver Bow Creek downstream of Butte have had low dissolved oxygen during the summer months (Naughton 2013). 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. 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. In 2019, we opted to forgo most multiple pass population estimates and rely primarily on single pass fish counts. These raw counts were standardized to catch per unit effort (CPUE), fish per minute of electrofishing time. Using CPUE versus an abundance estimate also allows for comparison to previous years in which multiple electrofishing passes were not conducted. We also did not repeat all sections in the fall due to inclement weather. Flows in Silver Bow Creek in 2019 were higher than average (Figure 5). Similar to the 2018 sampling, the higher flows likely reduced our capture efficiency (Cook and Elam, 2018).

At the Hwy 1 sampling section, one WCT (375 mm in length) was captured during the summer survey. Unlike the 2016-2018 summer surveys at this section, no EB or RB were captured (Table 3). Catch per unit effort of LN SU and LS SU were lower than the 2017 or 2018 surveys. No fall survey was conducted at HWY 1 due to bad weather and time constraints.

At the Fairmont section, 13 WCT (55-276 mm) and 4 EB (91-221 mm) were captured during the summer sampling. Catch per unit effort of these trout species were within the range of other summer surveys at this section (Table 3). One LN SU and one LS SU were also captured in the summer surveys, consistent with the low sucker numbers captured at this section in the past. No fall survey was conducted at Fairmont due to bad weather and time constraints.

At the German Gulch section, 38 WCT (103-361 mm) and 31 EB (74-230 mm) were captured. Catch per unit effort of WCT was within range of past summer surveys, but CPUE of EB was the highest recorded during summer sampling at this section. One young of year sucker (too small to identify to species) was captured in the summer survey of this section. Sucker numbers have been low to non-existent at in German Gulch sampling in recent years, particularly during fall surveys (Table 4). Suckers captured at German Gulch tend to be very small, mostly young of year fish. It is possible that the sucker population in this area has been suppressed by establishment of a robust trout population. No fall survey was conducted at German Gulch due to bad weather and time constraints.

During the summer survey of the Ramsay section, no trout were captured. This is the first time no WCT were captured since summer surveys began at Ramsay in 2016. The Ramsay section is with the area of Silver Bow Creek where low dissolved oxygen concentrations have limited the distribution and abundance of trout (Naughton 2013). It appears that trout in Silver Bow Creek near Ramsay are still limited, particularly during the summer months. Fifteen WCT

(208-422 mm) and four EB (155-278) were captured during fall sampling at Ramsay. Catch per unit effort of these trout species in fall 2019 were within the range observed since trout first became established in this section in 2007/2008 (Table 4). A two pass depletion estimate was also conducted at the Ramsay section in fall. WCT density was estimates at 4 fish/100m (4-5 95% CI), consistent with past fall estimates that have ranged from 3-6 fish/100m (Figure 6). A depletion estimate was also attempted for LN SU, but capture efficiency was too low to generate a reliable estimate. As noted in past surveys, trout redistribute into the Ramsay area in the fall when water temperatures and primary production decline. Sucker CPUE was relatively low in both the summer and fall 2019 surveys compared to past surveys of the Ramsay sections (Table 3 and 4).

At the Rocker section, no trout were captured during summer sampling. This is not surprising considering WCT have been captured in previous surveys in this section, but at low numbers (Tables 3 and 4). Catch per unit effort of LN SU in summer 2019 was within the range of past surveys of the Rocker section. Catch per unit effort of RM COT has increased at this section over the last four years. No fall survey was conducted at Rocker due to bad weather and time constraints.

During the summer survey of the LAO section, three WCT (263-305 mm) and three EB (220-278 mm) were captured. Catch per unit effort of both trout species were relatively high compared to past summer LAO surveys (Table 3). Captures of central mudminnow (CM MN) were also up compared to previous summer surveys. No LN SU were captured during the summer LAO survey. LN SU have been captured in every previous summer LAO survey, albeit at low numbers. During the fall survey at LAO, three WCT (268-290 mm) and one EB (318 mm) were captured. Catch per unit effort of these species were within the range of previous fall sampling events. No LN SU were captured in the fall, which is uncommon but not unheard of for fall LAO surveys (Table 4).

At the Father Sheehan section in August, 162 EB (63-351 mm) were captured. Catch per unit effort of EB was within the range of past surveys of this section (Table 4). Other species sampled include 63 RM COT, 20 LN SU, 1 CM MN, and one goldfish. This section is located near a park in Butte and it is likely that the goldfish was a previously a pet that was released into Blacktail Creek. No WCT were captured in the 2019 survey, although WCT have been captured in low numbers in the past. The Father Sheehan section is sampled only once a year.

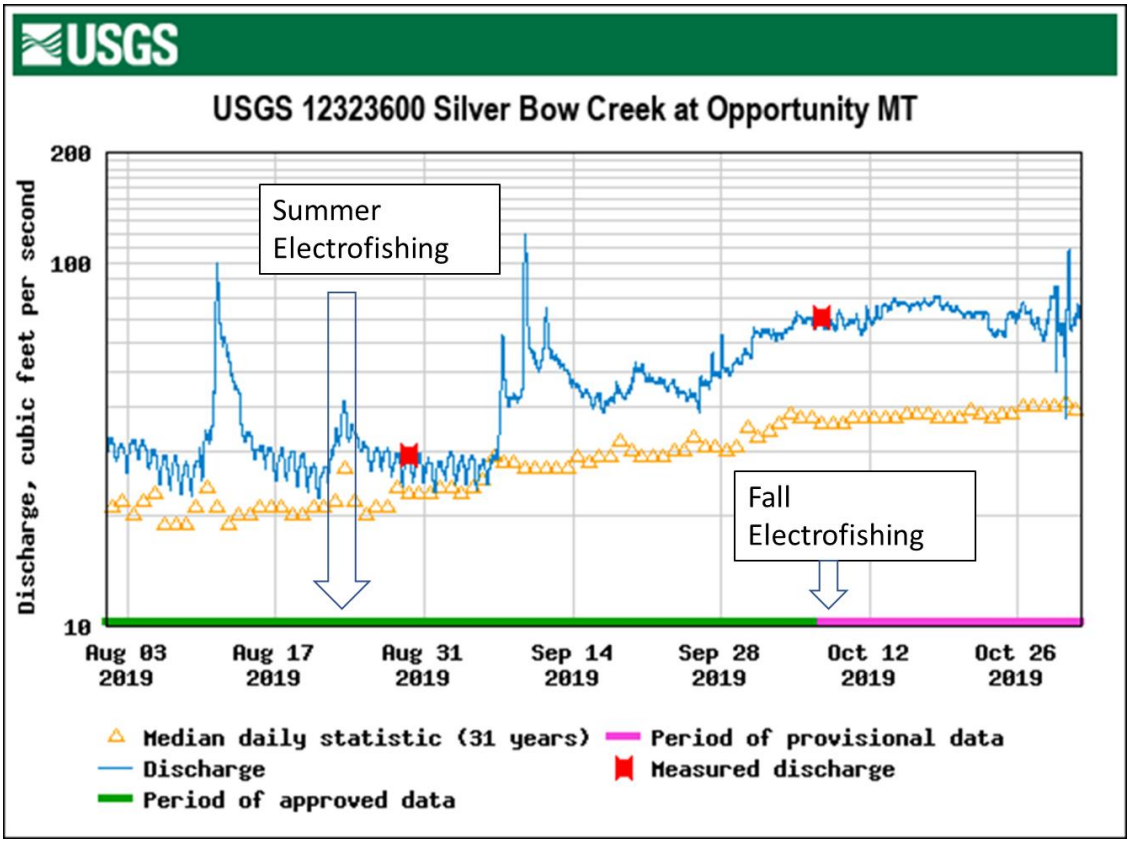

Figure 5. USGS hydrograph for the Silver Bow Creek gauge at Opportunity.

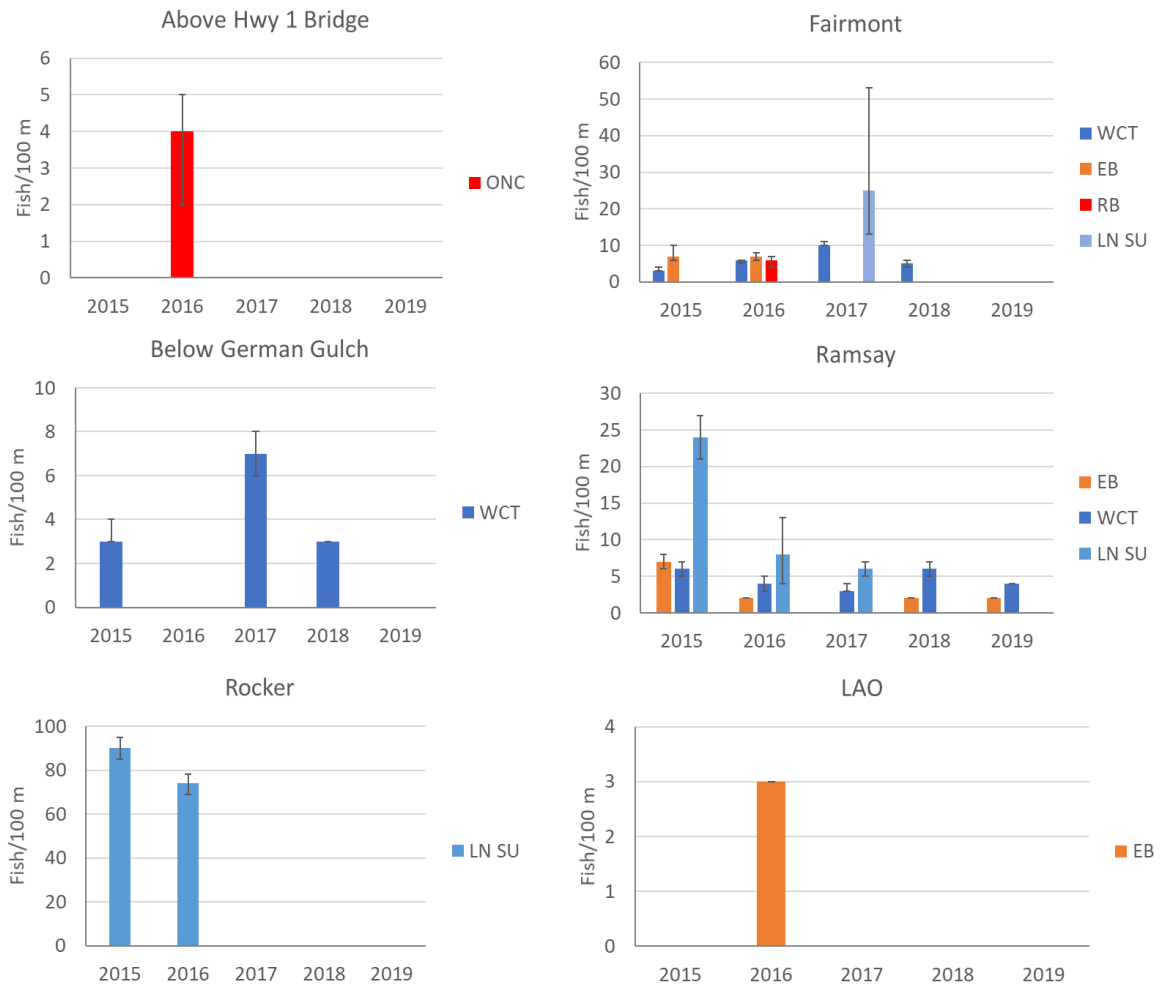

Figure 6. Fall population estimates at six sections of Silver Bow Creek.

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

Table 3. 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.

Section	Species	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Father	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**
Sheehan	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**
	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**
	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**
	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**
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
	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
	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
	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
	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
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
	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
	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
	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
	CM MN	0	0	0	0	0	0	0	0	0	0	0	0	0	0.389	0.045	0	0	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
	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
	LL	n/a	0	0	n/a	0	0	0	0	0	0	0	0	0	0	0.000	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
	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
	CM MN	n/a	0	0	n/a	0	0	0	0	0	0	0	0	0.046	0	0	0	0	0
German	WCT(w/RB)	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
Gulch	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
	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
	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
	CM MN	n/a	0	0	0	0	0	0	0	0	0	0	n/a	0	0	0	0	0	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
	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
	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
	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
	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
	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
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
	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
	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
	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
	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
	CM MN	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0	0	0	0	0	0	0	0	0	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

Table 4. Fish captured per minute of electrofishing in six 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 recently conducted during August (bold).

Table 5. Electrofishing data collected on Silver Bow Creek in August 2019.

section Name/RM	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)
Above Hwy 1 Bridge	LN SU	1	2	107	107	11
	LS SU	1	2	119	119	14
	RM COT	37	94	35-103	69	14
	WCT	1	2	375	375	551
Fairmont	EB	4	2	91-221	135	44
	LN SU	1	1	145	145	29
	LS SU	1	1	175	175	52
	RM COT	113	68	28-117	73	17
	RS SH	34	20	75-108	93	8
	WCT	13	8	55-276	139	70
Below German Gulch	EB	31	23	74-230	108	22
	RM COT	62	47	26-115	71	22
	SU	1	1	40	40	
	WCT	38	29	103-361	202	129
Ramsay	LN SU	32	34	36-188	106	21
	RM COT	61	66	35-117		
Rocker	CM MN	21	17	65-131	19	10
	LN SU	26	21	29-231	56	57
	RM COT	77	62	26-134		
LAO	CM MN	4	3	60-77	69	4
	EB	3	3	220-278	253	203
	RM COT	104	91	32-120		
	WCT	3	3	263-305	291	316
Father Sheehan	CM MN	1	<1	87	87	7
	EB	162	66	63-351	148	53
	GDF	1	<1	125	125	43
	LN SU	20	8	64-262	151	57
	RM COT	63	26	35-126		

Table 6. Electrofishing data collected on Silver Bow Creek in October 2019. Population estimates (95% CI) are for fish 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
Ramsay	EB	4	10	155-278	201	82	
	LN SU	12	29	45-227	140	55	
	RM COT	10	24	33-113			
	WCT	15	37	208-422	296	300	4 (4-5)
LAO	CM MN	1	3	111	111	14	
	EB	1	3	318	318	359	
	RM COT	29	85	42-115			
	WCT	3	9	268-290	280	258	

Warm Springs Creek Watershed

From July 8th to October 1st 2019, 21 sections in the Warm Springs Creek watershed were sampled, including six sections of the mainstem. Trout population estimates were attempted at all sections except one section of Barker Creek. Mark-recapture estimates consisting of one marking run and one recapture run were done on the three lower sections of Warm Springs Creek (WMA, Below Meyers Dam, and Garrity). Fish were captured for the mark recapture estimates using a tote-barge mounted electrofisher with one or two throwable electrodes. Mark-recapture estimates were generated for fish ≥ 150 mm. Prior to 2018, fish were captured in these sections using backpack electrofishers. Prior to the 2018 survey of the Garrity section, we determined that flows were too high to be effective with backpack units, so we decided to try the tote barge. We found the tote barge to be effective, especially in elevated flow conditions, so we transitioned to using it at all three mark recapture sections in 2019. The other 18 sections in the Warm Spring watershed were sampled using backpack electrofishers and population estimates were generated using the depletion method for fish ≥ 75 mm.

Mainstem Warm Springs Creek

At the WMA section, the LL estimate was 407 fish/km (350-484 95% CI). Average LL length was 222 mm (SD = 68.0). The 2019 LL estimate was less that the average for the WMA section, which is 593 fish/km (SD = 208.7). Suckers and sculpin were also present during sampling, but were not netted. At the Below Meyers Dam section, estimates were 443 LL/km (385-520) and 29 WCT/km (25-42). Average length for LL was 255 mm (SD = 61.2) and 298 mm for WCT (SD = 60.1). Nine BULL, 7 EB, 1 EBxBULL, 2 RB, and 5 RBxWCT were also captured in the Below Meyers Dam section (Table 7). At the Garrity section, estimates could be generated for LL, WCT, RBxWCT and BULL. Brown trout were estimated at 41/km (34-59), WCT at 121/km (103-152), RBxWCT at 18 fish/km (14-40), and BULL at 32/km (21-64). Fourteen SL COT were also captured at Garrity.

At the Veronica Trail section, the WCT estimate was 30 fish/100m (24-36 95% CI) and the EB estimate was 15 fish/100 m (14-16 95% CI). The WCT estimate was near the long-term average of 29 fish/100 m while the EB estimate was significantly higher than any previous year. Sixteen BULL, 1 RB, and 15 SL COT were captured in two electrofishing passes during this survey.

At the Upper Bridge section, the WCT estimate was 6 fish/100 m (5-7 95% CI) and the EB estimate was 9 fish/100 m (6-12 95% CI). The WCT estimate for this section was lower than any past survey (Figure 8) while the EB estimate was slightly lower than the average of past surveys (12 fish/100 m). Two BULL were also captured during this survey.

At the Upper Forks section, the WCT estimate was 80 fish/100m (76-84 95% CI) and the BULL estimate was 8 fish/100m (8-8 95% CI). The WCT estimate was significantly higher than any past estimate at this sampling section (Figure 8). BULL are captured at this section every year, but low densities have made it difficult to reliably calculate estimates in the past. No sculpin or other species have ever been captured at this section. This section is upstream of the part of Warm Spring Creek that flows underground and this subterranean portion apparently acts as a barrier to upstream movement of some fish species.

At the West Fork Warm Springs sampling section, the WCT estimate was 35 fish/100 m (33- 37 95% CI). Three BULL were also captured in this section.

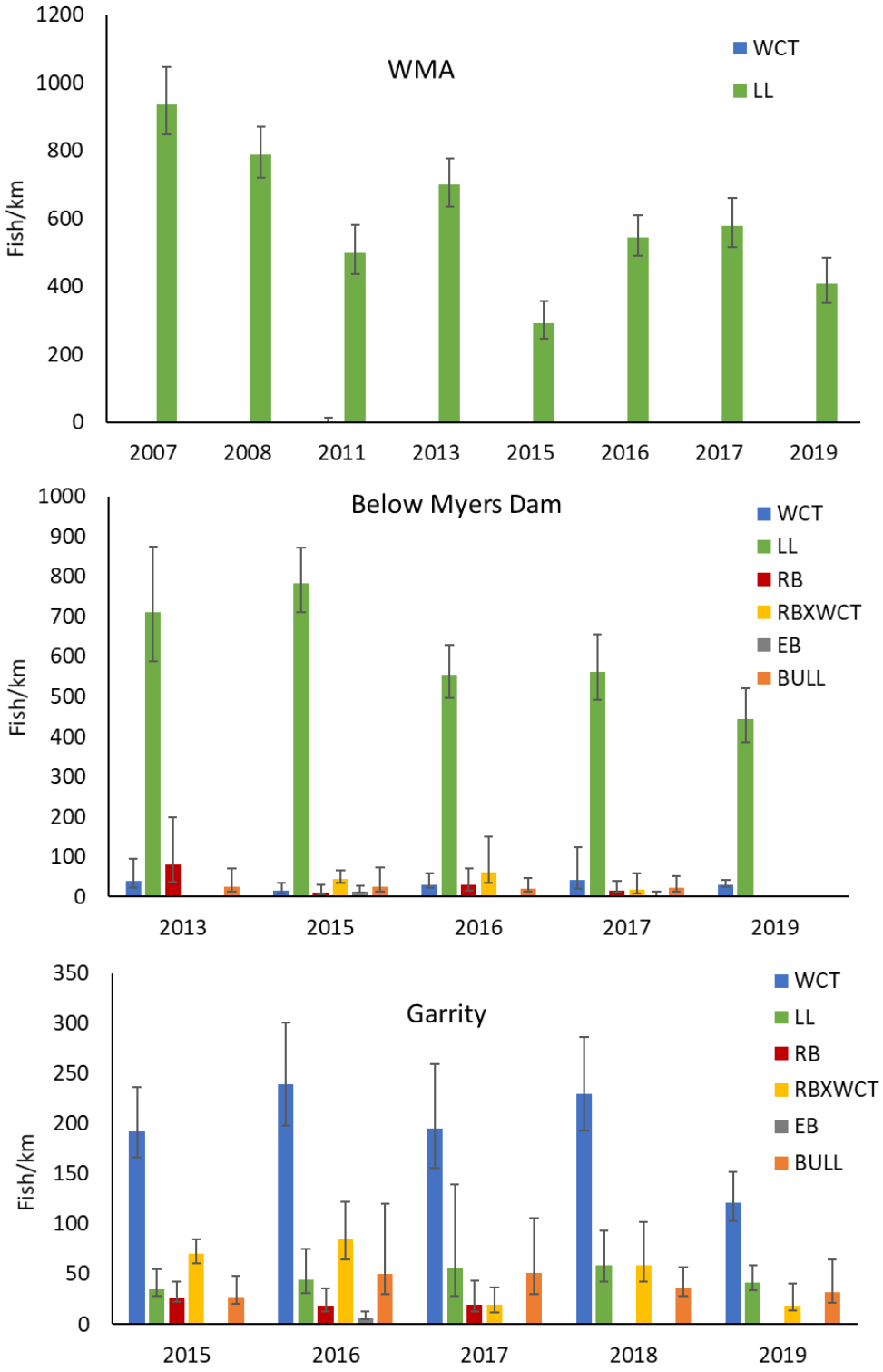

Figure 7. Warm Springs Creek 2019 mark-recapture trout population estimates. Estimates are for fish ≥ 150 mm. Error bars are 95% CI.

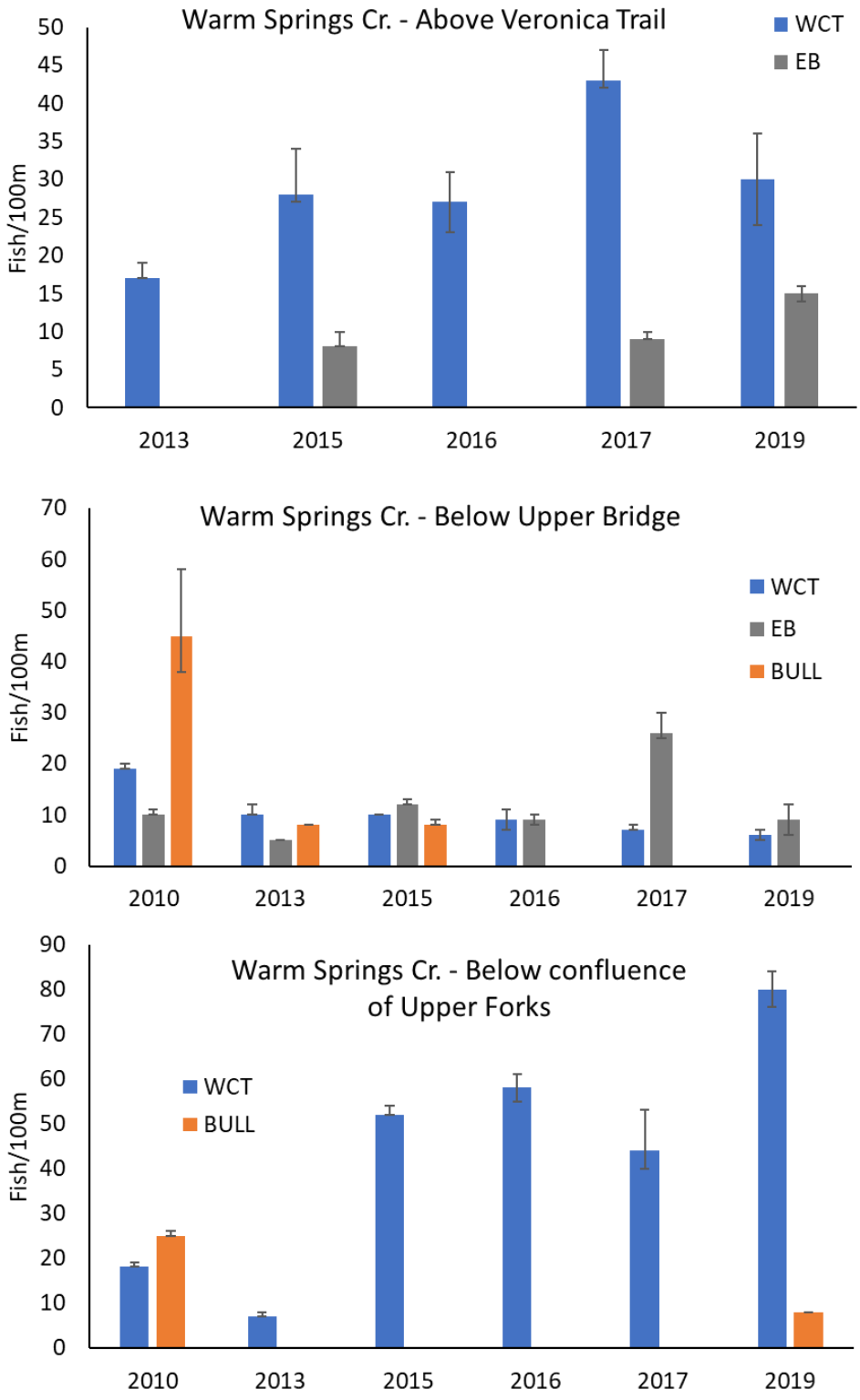

Figure 8. Warm Springs Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI.

Table 7. Electrofishing data collected on Warm Springs Creek and West Fork Warm Springs Creek, 2019. Population estimates are presented in figures above.

section Name/RM	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)
WMA	LL	262	100	141-503	222	141
Below Meyers Dam	BULL	9	3	147-370	234	124
	EB	7	2	151-255	177	61
	EBXBULL	1	<1	547	547	1545
	LL	308	87	150-409	255	197
	RB	2	<1	253-281	267	185
	RBXWCT	5	1	161-385	262	234
	WCT	21	6	165-400	298	281
Garrity WMA	BULL	22	8	55-313	224	110
	EBXBULL	1	1	148	148	25
	LL	40	15	118-380	264	243
	RB	16	6	90-294	176	87
	RBXWCT	33	13	78-306	158	58
	WCT	147	57	42-372	191	105
Veronica Trail	BULL	16	25	49-173	124	22
	EB	15	24	90-183	123	19
	RB	1	2	151	151	38
	WCT	31	49	60-396	165	73
Upper Bridge	BULL	2	12	181-210	196	67
	EB	9	53	96-234	166	64
	WCT	6	35	146-266	211	119
Below upper forks	BULL	9	10	72-181	141	27
	WCT	79	90	72-220	148	38
West Fork RM 1.0	BULL	3	7	116-155	130	20
	WCT	39	93	71-184	124	23

Foster Creek

Fish population surveys were conducted at three sections on Foster Creek in 2019. At the River Mile 1.0 section, the WCT estimate was 51 fish/100m (49-53 95% CI) and the BULL estimate was 33 fish/100m (21-71 95% CI). Two EB and one RBxWCT hybrid were also captured in this section (Table 8). At the River Mile 2.3 section, only 11 WCT and one BULL were captured on the first electrofishing pass. So, no additional passed were conducted and abundance estimates were not conducted. At the River Mile 3.8 section, the WCT estimate was 40 (35-45) fish/100 m. One EB was also captured in this section.

Barker Creek

Two sections were sampled on Barker Creek in 2019. At the River Mile 0.5 section, the BULL estimate was 33 fish/100 m (27-39 95% CI) and the WCT estimate was 12 fish per 100 m (10-14 95% CI). With the exception of one EB that was captured at the lower section in 2015, BULL and WCT have been the only species observed in Barker Creek.

Twin Lakes Creek

Five sections on Twin Lakes Creek were sampled in 2019. Depletion estimates were done at all but the section below the lower lake (river mile 7.2). Multiple electrofishing passes were not attempted at this section because of low fish densities. At the River Mile 1.3 section, the WCT estimate was 19 fish/100 m (15-23). Three BULL, 1 EB, 1 RBxWCT hybrid, 2 RM COT and 2 SL COT were also captured (Table 9). At the River Mile 2.8 section, the WCT estimate was 18 fish/100 m (16-20) and the EB estimate was 23 fish/100 m (19-27). Two BULL, 10 RM COT, and 5 SL COT were also captured in this section. At the River Mile 4.6 section, the WCT estimate was 20 fish/100m (18-22), which is close to the average of 22 fish/100 m for this section. One BULL, 3 EB, 6 RM COT, and 6 SL COT were also captured at the RM 4.6 section. At the section below the lower lake at river mile 7.2, a single electrofishing pass yielded 2 BULL and 6 WCT. At the section above the upper Twin Lake at river mile 8.5, the WCT estimate was 13 fish/100 m (8-18), which is the lowest estimate we have recorded for this section. Seven BULL were also captured at the RM 8.5 section.

Storm Lake Creek

Four sections of Storm Lake Creek were sampled in 2019. Some of these sections have been sampled since 2007, although depletion-based population estimates were not attempted until 2010. At river mile 0.6 section, the WCT estimate was 15 fish/100 m (8-22) and the EB estimate was 11 fish/100 m (9-13). Both of these estimates were near the long-term averages of 15 (WCT) and 12 (EB) for the RM 0.6 section. At the river mile 1.4 section, the WCT estimate was 24 fish/100 m

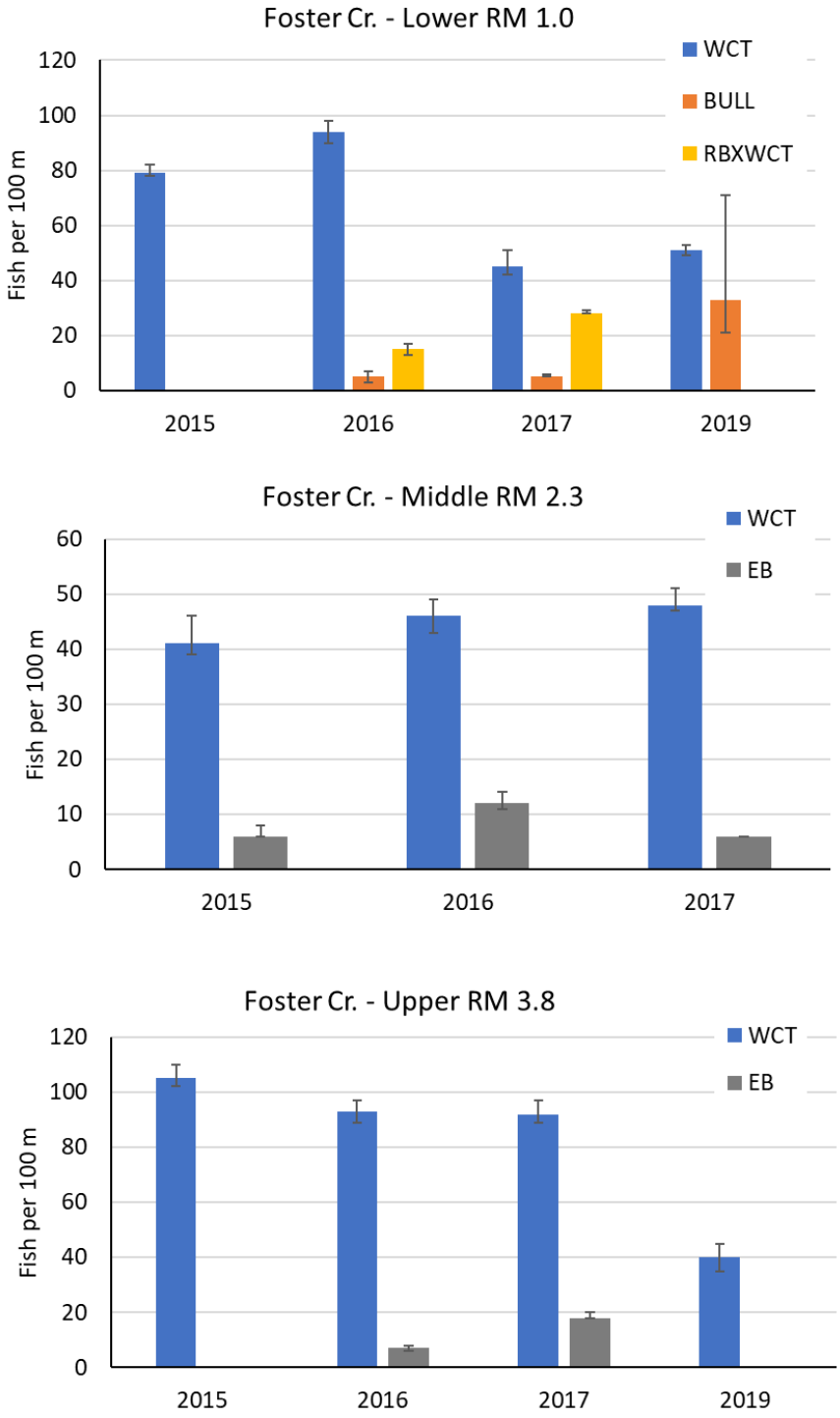

Figure 9. Foster Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI.

Table 8. Electrofishing data collected on Foster Creek, 2019. Population estimates (95% CI) are for fish 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
RM 1.0	BULL	21	24	98-176	110	13	33 (21-71)
	EB	5	6	99-189	130	28	
	RBXWCT	2	2	160-241	201	92	
	WCT	59	68	54-261	145	43	51 (49-53)
RM 2.3	BULL	1	8	224	224	94	
	WCT	11	92	55-216	101	31	
RM 3.8	EB	1	2	70	70	3	
	WCT	48	98	35-213	117	27	40 (35-45)

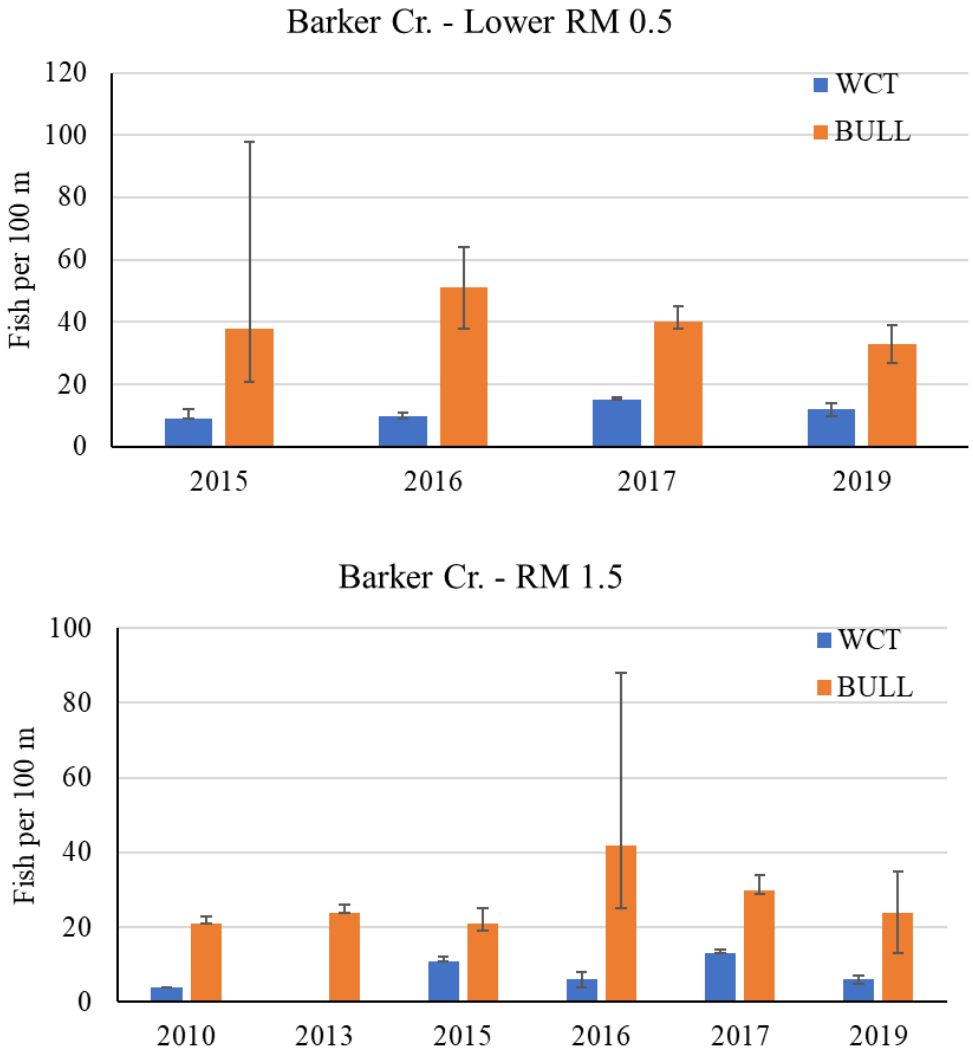

Figure 10. Barker Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI.

section Name/RM	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)	Estimate per 100m
RM 0.5	BULL	34	74	33-206	42	20	33 (27-39)
	WCT	12	26	106-269	47	85	12 (10-14)
RM 1.5	BULL	26	79	30-210	49	24	24 (13-35)
	WCT	7	21	45-253	73	84	6 (5-7)

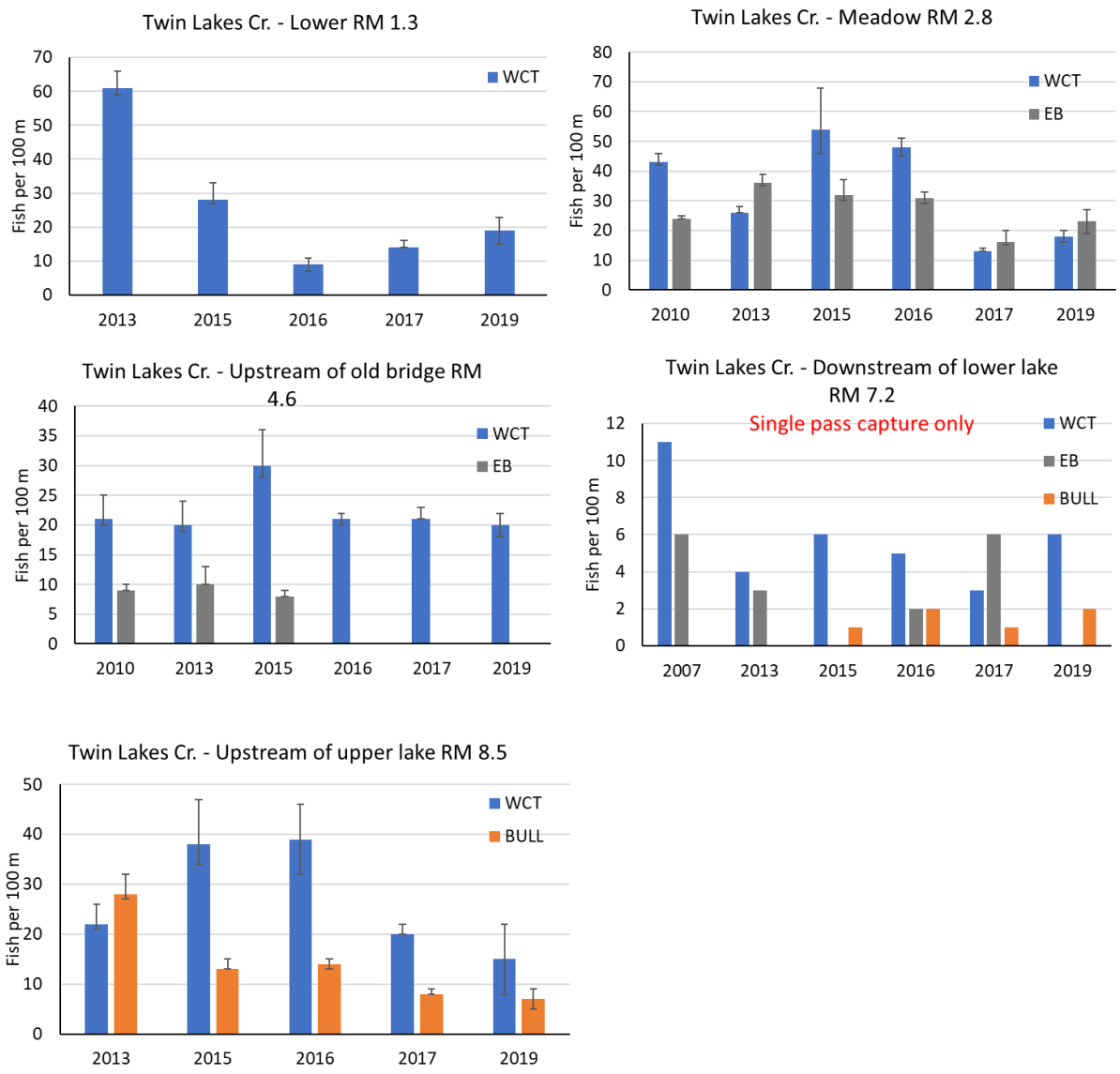

Figure 11. Twin Lakes Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI.

Table 9. Electrofishing data collected on Twin Lakes Creek, 2019. Population estimates (95% CI) are for fish 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
RM 1.3	BULL	3	11	70-129	92	7	
	EB	1	3	168	168	40	
	RBXWCT	1	3	228	228	129	
	RM COT	2	7	102-117	110	16	
	SL COT	2	7	69-73	71	4	
	WCT	20	69	52-218	144	36	19
RM 2.8	BULL	2	3	232-345	289	241	
	EB	22	38	88-233	151	37	23
	RM COT	10	17	74-106	89	8	
	SL COT	5	9	75-109	84	7	
	WCT	19	33	34-255	140	34	18
RM 4.6	BULL	1	3	143	143	23	
	EB	3	8	114-164	146	30	
	RM COT	6	16	75-105	93	9	
	SL COT	6	16	71-98	86	7	
	WCT	21	57	64-219	142	36	20
RM 7.2	BULL	2	25	150-155	153	27	
	WCT	6	75	130-264	171	59	
RM 8.5	BULL	7	37	55-120	79	16	
	WCT	12	63	102-336	197	98	13

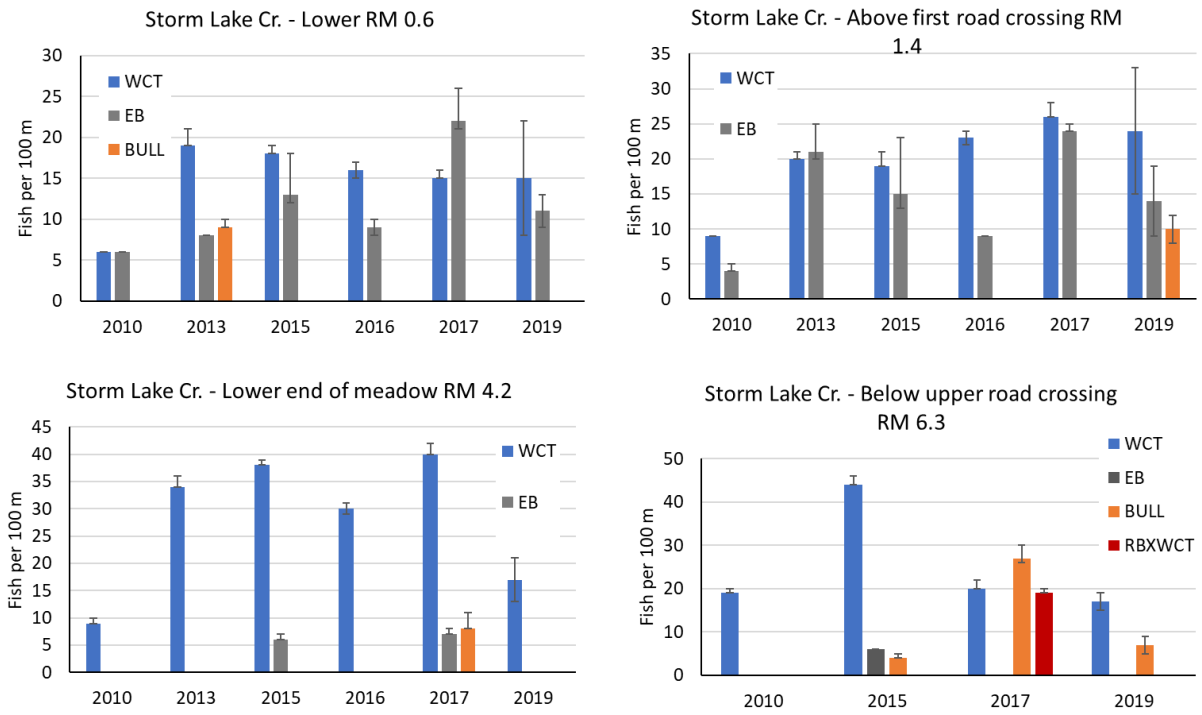

Figure 12. Storm Lake Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI.

Table 10. Electrofishing data collected on Storm Lake Creek, 2019. Population estimates (95% CI) are for fish 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 RM 0.6	BULL	1	4	137	137	25	
	EB	11	39	90-231	140	40	11 (9-13)
	WCT	16	57	56-220	122	31	15 (8-22)
RM 1.4	BULL	10	22	105-224	139	28	10 (8-12)
	EB	13	28	79-176	140	31	14 (9-19)
	WCT	23	50	54-246	135	40	24 (15-33)
RM 4.2	BULL	6	22	55-176	122	28	
	EB	1	4	131	131	21	
	RB	2	7	144-166	155	41	
	WCT	18	67	50-211	149	43	17 (13-21)
RM 6.3	BULL	9	23	72-175	105	16	7 (5-9)
	EB	2	5	119-226	173	53	
	RBXWCT	6	15	115-158	139	28	
	WCT	22	57	57-310	130	46	17 (15-19)

Little Blackfoot River

Methods and results

Six sections of the Little Blackfoot River were sampled in 2019. These sections were sampled semi-annually from 2007-2013 and annually from 2015-2017. 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. The four upstream sections were sampled using two backpack units and depletion population estimates were generated.

At the FAS section, the LL estimate was 651 fish/km (63-96), which is not statistically different than the long term mean for the section which is 740 fish/km. At the North Trout Creek section, the LL estimate was 423 (34-47). 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). The WCT estimate for the North Trout Creek section was 46 fish/km (15-51), which is the second highest estimate since surveys began in 2007. It is common for WCT numbers to spike in the Little Blackfoot River in years following high flow years (Jason Lindstrom, pers. communication).

At the sampling section above the HWY 12 bridge, the LL estimate was 25 fish/100 m (10-39). The WCT estimate for this section was 5 fish/100 m (4-7) and the EB estimate was 7 fish/100 m (1-13). Mountain whitefish estimates were conducted at the HWY 12 section and sections upstream in the past, but not MWF estimates were conducted in 2019. At the Sunshine Camp section, the WCT estimate was 9 fish/100 m (6-11) and the LL estimate was 8 fish/100 m (4-12). Five EB were also captured. At the Ontario Creek section, the LL estimate was 25 fish/100 m (22-28). One EB and 13 WCT were also captured in the Ontario Creek section but a depletion estimate could not be achieved for these species. At the Kading Campground section, the WCT estimate was 22 fish/100 m (14-29), the LL estimate was 5 fish/100 m (4-6), and the EB estimate was 17 fish/100 m (16-18).

Discussion

It appears that changing from backpack electrofishing to barge electrofishing in the FAS and North Trout Creek sections did not significantly bias the estimates in 2019. Brown trout numbers in 2019 were comparable to those from 2017, which is the last year these sections were sampled with backpack electrofishers. We will continue to use a barge unit to achieve mark-recapture estimates in these sections due to the increased sampling efficiency, which is especially important during high water years. This change in methodology should not impair our ability to compare past and future estimates for these sections.

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 12). 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 38% 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. High flows in 2018 likely increased WCT recruitment to this area of the Little Blackfoot River (Jason Lindstom, 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.

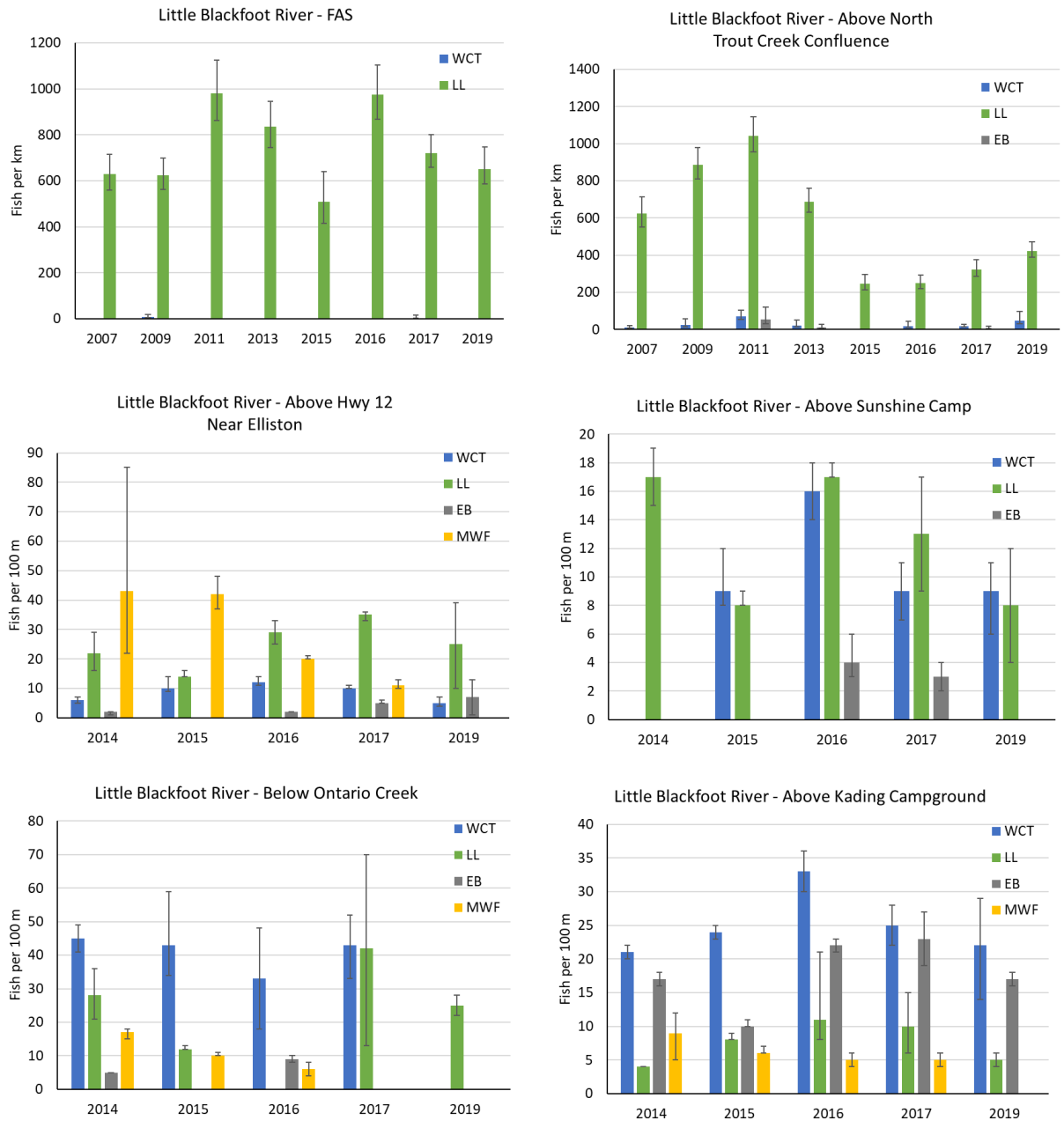

Figure 12. Fish population estimates for six sections of the Little Blackfoot River. Note that estimates for the FAS and North Trout Creek sections are mark/recapture estimates and are in fish/km and are for fish ≥ 150 mm. Estimates for the other four sections are depletion estimates, are in fish per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

Section Name/RM	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)	Estimate *per km* or 100 m
FAS	LL	558	99	150-595	289	253	*651 (588-747)*
	WCT	2	1	217-307	262	175	
N. Trout Cr.	EB	4	1	203-297	239	143	
	LL	351	91	150-650	286	263	*423 (389-470)*
	WCT	29	8	223-403	308	313	*46 (31-97)*
HWY 12 Bridge	EB	16	20	99-215	166	49	7 (1-13)
	LL	50	62	152-412	239	171	25 (10-39)
	WCT	15	18	92-372	228	157	5 (4-7)
Sunshine Camp	EB	5	14	104-163	130	21	
	LL	14	39	95-303	198	95	8 (4-12)
	WCT	17	47	70-360	195	110	9 (6-11)
Ontario Cr.	EB	1	3	95	95	7	
	LL	29	67	118-271	191	75	25 (22-28)
	WCT	13	30	64-219	157	50	
Kading Camp	EB	34	43	70-195	134	28	17 (16-18)
	LL	9	11	85-272	166	67	5 (4-6)
	WCT	36	46	96-253	168	52	22 (14-19)
	WCT	12	63	102-336	197	98	13

Table 11. Electrofishing data collected on the Little Blackfoot River, 2019. Population 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.

Harvey Creek

Methods and results

Five sections of Harvey Creek were sampled in 2019. The three downstream sections (at river miles 0.6, 1.2, 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 WCT estimate was 23 fish/100 m (19-27). The average WCT estimate for this section is 34 fish/100 m. One BULL that was 161 mm was captured in this section in 2019. This is the first time bull trout have been captured in this section. At the River Mile 1.2 section, the WCT estimate was 43 fish/100 m (38-48) and the BULL estimate was 6 fish/100 m (4-8). The 2019 survey was the first time BULL have been captured in the RM 1.2 section of Harvey Creek. The BULL captured in this section were primarily juveniles with an average length of 156 mm. At the River Mile 1.6 section, the WCT estimate was 64 fish/100 m (55-73) and the BULL estimate was 9 fish/100 m (7-11). 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). Another sampling section at river mile 2.3 was sampled in 2012 and 2014-2017, but this section was not sampled in 2019.

At the Below 8 Mile section, the WCT estimate was 73 fish/100 m (64-82) and the BULL estimate was 20 fish/100 m (18-23). Both trout estimates were slightly above the averages of 69 WCT/100 m and 17 BULL/100 m for this section, but these differences are not statistically significant. At the Above FS Road section, the WCT estimate was 41 fish/100 m (18-64) and the BULL estimate was 28 fish/100 m (24-32). Both of these trout estimates were slightly above the averages of 37 WCT/100 m and 27 BULL/100 m for this section, but these differences are not statistically significant.

Discussion

The detection of bull trout at the River Mile 0.6 section is the most downstream that BULL have been documented in Harvey Creek. Seven BULL were captured in the RM 1.2 section in 2019 and this species had not been found in this section in the past. At the RM 1.6 section, 18 juveniles were captured in 2019, which is the most BULL ever captured the lower reaches of Harvey Creek. Hopefully, the increase in BULL abundance in lower Harvey Creek continues in the future and the species becomes established. 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.

The sampling sections on Forest Service Land are at river mile 7.5 (Below 8 Mile Creek section) and 8.5 (Above FS Road section), so they are well upstream of current restoration activities. As such, these upstream sections can serve as useful comparisons when assessing the effects of restoration actions in the downstream reaches of Harvey Creek. Compared to the RM 1.6 section of Harvey Creek, the WCT population upstream on Forest Service land has been relatively steady over time. At the Below 8 Mile section, WCT have ranged from 62-73 fish/100 m from 2012 to 2019. At the Above FS Road section, WCT have ranged from 32-41 fish/100 m over the same time period. The BULL estimates at the Below 8 Mile section have been steady from 2012-2019, ranging from 13-20 fish/100 m. The BULL population at the Above FS Road section has been more variable, ranging from 12-40 fish/100 m from 2014-2019. During future monitoring efforts, it will be important to consider trends in the upstream sampling sections and use these data as controls to which to assess potential benefits of restoration in the downstream reaches.

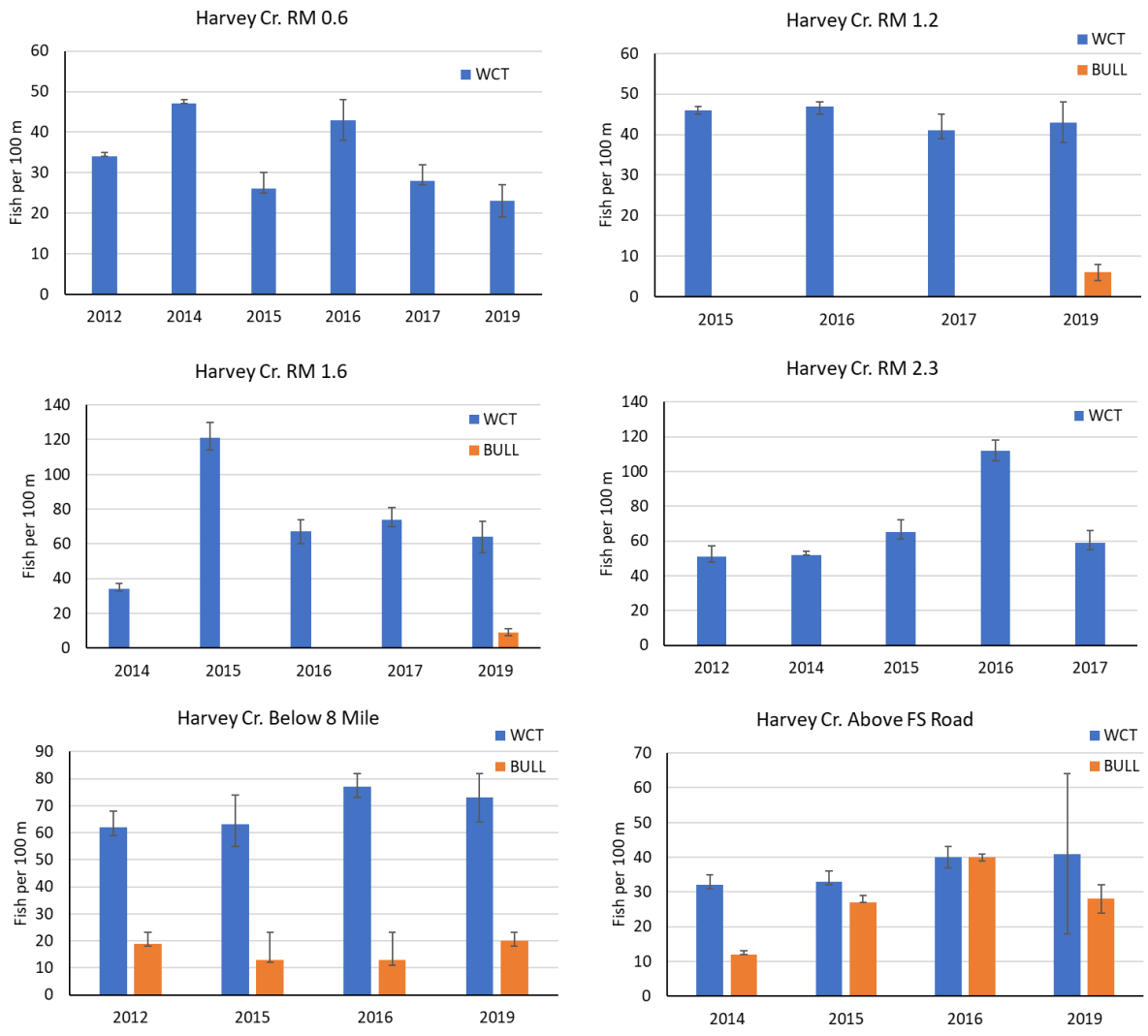

Figure 13. Harvey Creek depletion population estimates for fish ≥ 75 mm. Error bars are 95% CI.

Table 12. Electrofishing data from Harvey Creek, 2019.

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	2	161	161	40	
	WCT	43	98	45-310	122	56	23 (19-27)
RM 1.2	BULL	7	13	134-219	156	38	6 (4-8)
	WCT	48	87	99-351	145	54	43 (38-48)
RM 1.6	BULL	18	23	59-151	103	17	9 (7-11)
	WCT	59	77	89-339	136	48	64 (55-73)
Below 8 Mile	BULL	36	26	57-282	130	38	20 (18-23)
	WCT	102	74	40-282	124	38	73 (64-82)
Above FS Road	BULL	28	45	58-213	127	21	28 (24-32)
	WCT	34	55	38-231	126	36	41 (18-64)

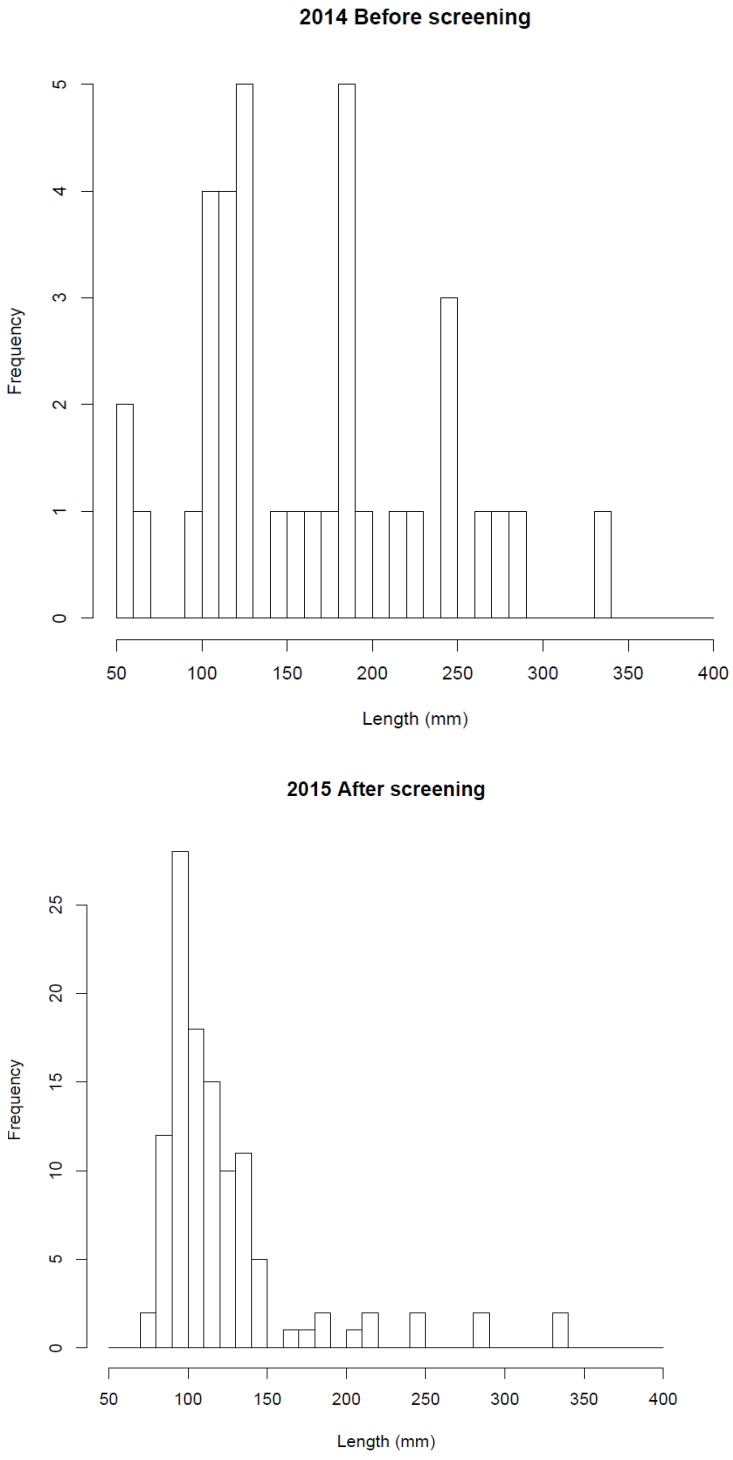

Figure 14. Length-frequency histograms for Westslope cutthroat trout captured in the River Mile 1.6 section of Harvey Creek before and after a fish screen was installed directly upstream.

Flint Creek

Three sampling sections were sampled on Flint Creek in 2019. These sections were sampled annually from 2014-2017. Fish were collected using a barge mounted electrofishing unit with a throwable anode. Mark-recapture population estimates were calculated for trout ≥ 150 mm.

At the Hall section, the 2019 brown trout estimate was 599 fish/km (503-723). This estimate is the highest recorded for the Hall Section. One BULL (392 mm) and seven WCT (228-347 mm) were also captured (Table 13). One BULL was also captured at the Hall section in 2016 and 2017. The LL estimate for the Johnson Tuning Fork section was 528 fish/km. This was the highest brown trout estimate recorded at Johnson Tuning Fork. One EB, two RB, and one WCT were also captured. At the Chor section, the LL estimate was 350 fish/km and the EB estimate was 7 fish/km (2-8). Although not statistically higher than 2017, the 2019 brown trout estimate was Chor was the highest ever recorded at this section. One RB was also captured at the Chor section.

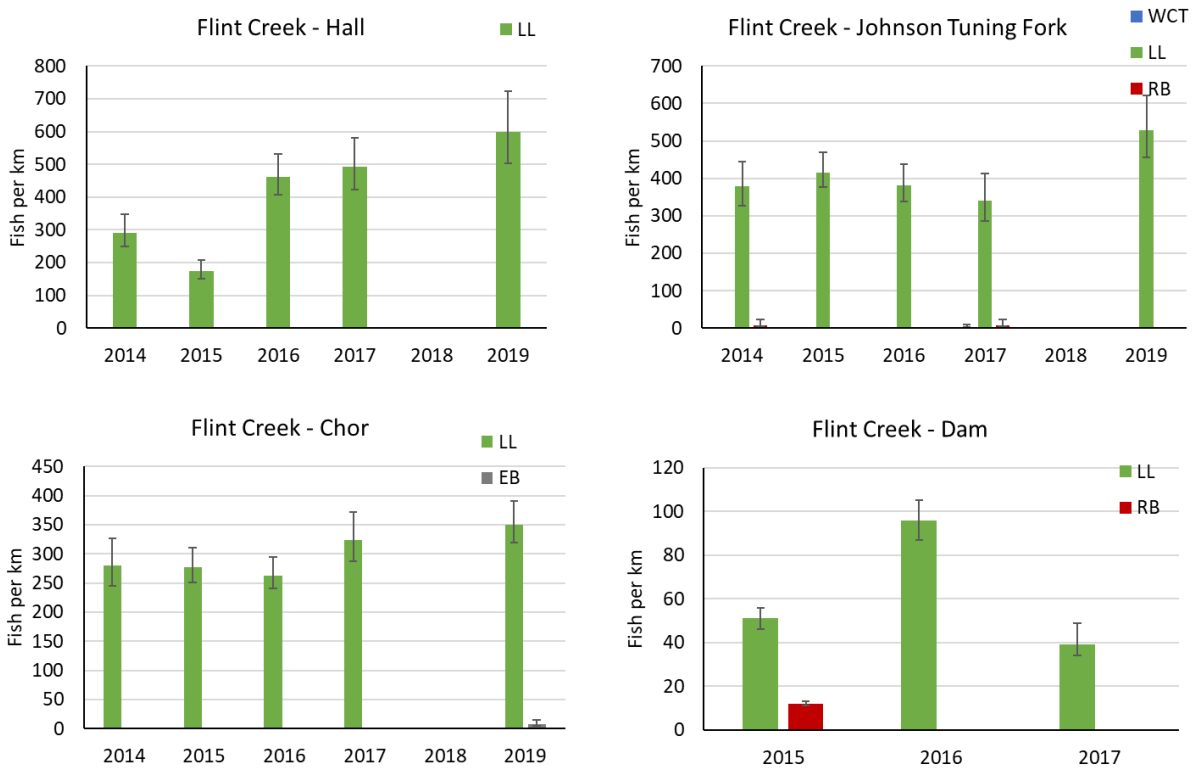

Figure 15. Flint Creek trout population estimates. Error bars are 95% CI. The Dam section was not sampled in 2019.

Table 13. Electrofishing data from Flint Creek, 2019.

section Name	Species	# Fish Handled	Species Composition (%)	Length Range (mm)	Average Length (mm)	Average Weight (g)
Hall	BULL	1	1	392	392	445
	LL	474	98	151-530	267	234
	WCT	7	2	228-347	298	286
Johnson Tuning Fork	EB	2	<1	235-301	268	215
	LL	424	99	153-468	243	171
	RB	2	<1	192-201	197	75
	WCT	1	<1	225	225	100
Chor	EB	9	2	195-275	239	156
	LL	397	97	150-527	254	220
	RB	1	<1	403	403	685

References

Chapman, D. G. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. University of California Publications on Statistics 1:131-160.

Clark Fork Coalition, 2019. Upper Clark Fork Stream Survey. May, 2019.

Cook, N. A., and T. Elam. Monitoring in the Upper Clark Fork River Basin: 2018 Report. Montana Fish Wildlife and Parks, Helena, Montana.

Cook, N. A., P. Saffel, B. Liermann, J. Lindstrom, and T. Selch. 2015. Upper Clark Fork River Fisheries Monitoring Study: 2015 Annual Report. Montana Fish Wildlife and Parks, Helena, Montana.

Cook, N. A., T. Elam, B. Liermann, J. Lindstrom, and P. Saffel. 2017. Fisheries Monitoring in the Upper Clark Fork River Basin: 2017 Report. Montana Fish Wildlife and Parks, Helena, Montana.

Geum Environmental. 2015. Upper Clark Fork River Basin Aquatic Resources Restoration Plan Monitoring and Maintenance Plan. Prepared for the Natural Resource Damage Program, Montana Department of Justice, Helena, Montana.

Mayfield, M.P. 2013. Limiting factors for trout populations in the upper Clark Fork River Superfund site, Montana. M.S. Thesis, Montana State University, Bozeman, Montana. Available: http://etd.lib.montana.edu/etd/view/item/1883.

Naughton, J.P. 2013. Salmonid response to superfund remediation in Silver Bow Creek, Montana. M.S. Thesis, Montana State University, Bozeman, Montana.

Liermann, M, J. Lindstrom, and R. Kreiner. 2009. An Assessment of Fish Populations and Riparian Habitat in Tributaries of the Upper Clark Fork River Basin: Phase II. Montana Fish Wildlife and Parks, Helena, Montana.

Lindstrom, J., B. Liermann, and R. Kreiner. 2008. An assessment of fish populations and riparian habitat in tributaries of the upper Clark Fork River Basin. Montana Fish Wildlife and Parks, Helena, Montana.

Saffel, P., N. Cook, B. Liermann, J. Lindstrom, L. Knotek, D. Martin, and B. Downing. 2018. Prioritization of Areas in the Upper Clark Fork River Basin for Fishery Enhancement. Montana Fish, Wildlife and Parks, Missoula, MT and Natural Resource Damage Program, Helena, MT.

Zippin, C. 1958. The removal method of population estimation. Journal of Wildlife Management 22: 82-90.