Fisheries Division
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Montana Statewide Fisheries Management

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Abstract: This report summarizes bull trout passage work conducted in the Warm Springs Creek drainage from 2010 through 2015 relative to barriers associated with the Silver Lake Water System.

Warm Springs Creek Drainage Bull Trout Passage

2010-2015

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Cover Photo: Adult bull trout captured and passed at Silver Lake Diversion on Storm Lake Creek, MT

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INTRODUCTION

The Warm Springs Creek drainage near Anaconda, MT supports some of the last remaining bull trout populations in the Clark Fork River watershed upstream of the confluence of Flint Creek (near Drummond, MT). Bull trout are currently listed under the Federal Endangered Species Act as a Threatened Species, and have been since 1998. The species occurs with relative frequency in the mainstem of Warm Springs Creek from approximately the city of Anaconda to the headwaters. Additional populations are present in tributary drainages to Warm Springs Creek including Foster Creek, Barker Creek, Twin Lakes Creek, and Storm Lake Creek. Since the early 1900s, the Warm Springs drainage has been extensively fragmented by a water supply system originally constructed to provide water for large-scale copper smelting in Anaconda. The water system, known as the Silver Lake Water System, is currently owned by the consolidated city and county of Butte – Silver Bow (BSB), and is managed by the BSB public works department to supply industrial water to several customers between Anaconda and Butte. The Silver Lake Water System contains an intricate water conveyance network made up of diversion structures, ditches, aqueducts, exposed and buried pipes, and also includes two managed reservoirs (Storm and Silver Lakes). Many of these structures clearly influence habitat connectivity within the system, and have caused the isolation of bull trout populations in upper Twin Lakes Creek, Storm Lake Creek, and upper Warm Springs Creek. An examination of genetic patterns of bull trout populations in the Warm Springs drainage completed by the U.S. Fish and Wildlife Service in 2008 and 2009 confirmed this (DeHaan and Godfrey 2010). Findings showed that most of the populations were genetically distinct, and there was little evidence of genetic mixing. Additionally, the study also showed that the effective population size of most of the populations was alarmingly low.

The heart of the Silver Lake Water System is Silver Lake. This over 300-acre reservoir is located near the top of the Warm Springs drainage, and is filled by water diverted from Storm Lake Creek and Twin Lakes Creek (Figure 1). Approximately the lower mile of Storm Lake Creek has been completely re-channeled (ditched) to run directly into the lake year-round. A diversion structure that allows water to bypass the lake when it is at full pool is located near where the stream enters the lake (Figure 1). This structure is an effective year-round barrier to upstream fish movement, and it blocks the spawning migrations of bull trout returning to Storm Lake Creek from Silver Lake (Figure 2). On Twin Lakes Creek, a large concrete diversion located approximately 2 miles upstream from the mouth allows for the seasonal diversion of water to Silver Lake during the summer months (Figure 1). This structure is a year-round barrier to upstream fish migration (Figure 3). Water that is stored in Silver Lake is released downstream via an aqueduct that eventually runs into Warm Springs Creek near its confluence with Twin Lakes Creek (Figure 1). From there, water flows down Warm Springs Creek for several miles before it is diverted out of the basin at Meyer's Dam (Figure 1). Meyer's Dam, located just a few miles west of Anaconda, is a large concrete dam that is an effective upstream barrier to fish found downstream of it (Figure 4). Given the presence of these three significant migratory barriers and the recent findings from the USFWS genetic study, the decision was made to investigate the possibility of capturing and moving bull trout over these structures. The goal was to increase spawning success and genetic mixing of bull trout in the Warm Springs drainage.

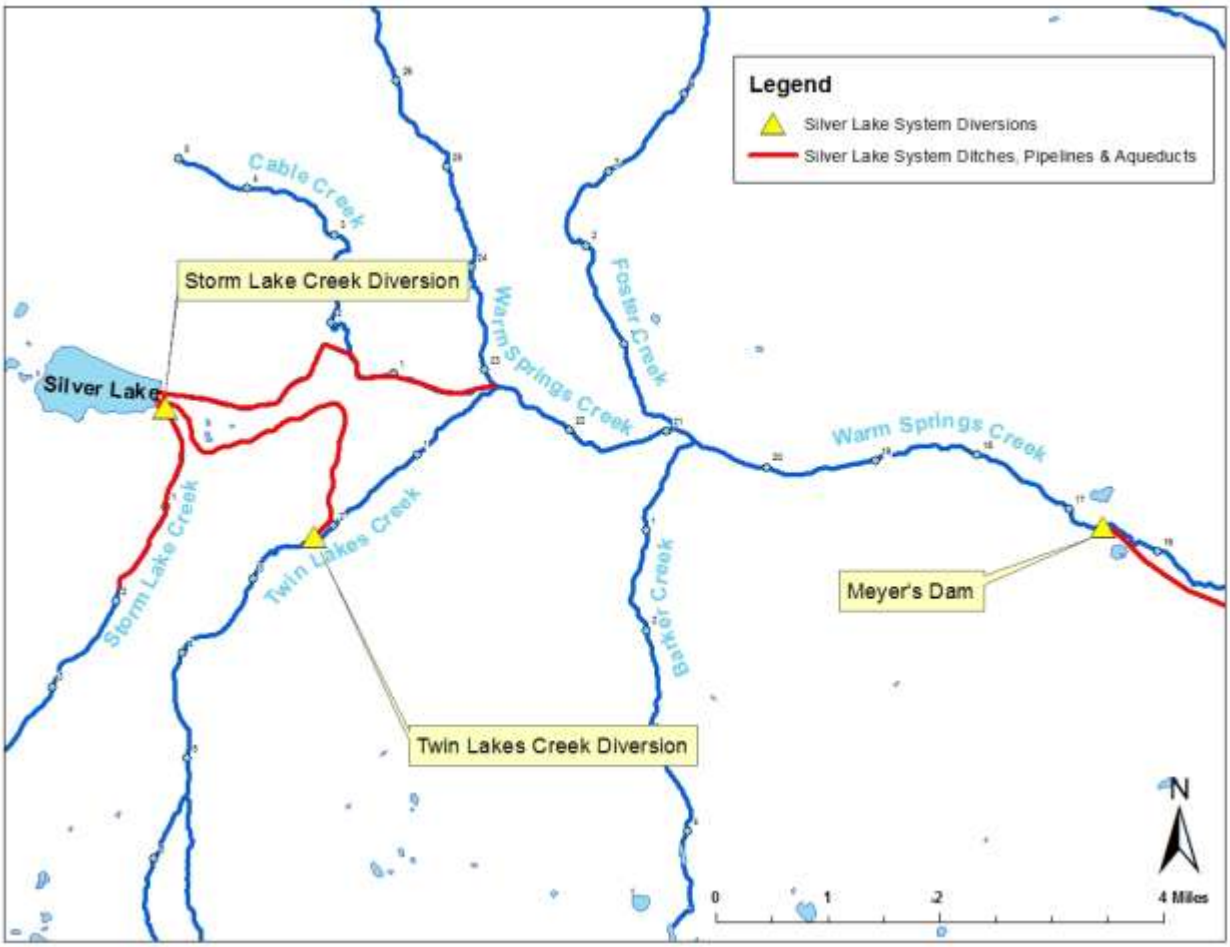

Figure 1. Map of the upper Warm Springs Creek drainage depicting locations of key structures of the Silver Lake Water System.

Figure 2. Silver Lake Diversion near mouth of Storm Lake Creek.

Figure 3. Silver Lake Diversion on Twin Lakes Creek.

Figure 4. Meyer's Dam on Warm Springs Creek just west of Anaconda, MT.

METHODS

Selective bull trout passage in the Warm Springs drainage began in 2010, and initially focused on the diversion on Storm Lake Creek for the first three years, with minor effort also directed to the structure on Twin Lakes Creek. In 2012, sampling was expanded to include Warm Springs Creek below Meyer's Dam. Sampling became much more regular at all three diversion locations starting in 2013. Sampling frequency was variable at each of the sites and among each of the sample years. The most effort was directed to the diversion on Storm Lake Creek because of the higher numbers of fish encountered, as well as the higher success of fish capture at the site. Sampling at this location was often completed two times per week between mid-July and mid-September. Sampling at the other two sites was somewhat less regular, but still was typically completed weekly or every other week during the same period.

Sampling at all sites typically consisted of electrofishing with a single back pack electrofisher (Smith-Root LR24) using one or two dip netters to capture fish present in habitat immediately below each diversion structure. In many, but not all cases, fish other than bull trout were collected during sampling. All fish captured were identified to species based on phenotypic characteristics, weighed and measured. Fin clips were collected from all bull trout and bull trout/brook trout hybrids for later genetic analysis. Only bull trout were passed over each of the diversion structures. Hybrid bull trout and all other species were returned to the stream below the diversions.

From 2011 to 2013, passive integrated transponder (PIT) tags were implanted into a number of bull trout captured below the diversion on Storm Lake Creek. Using a surgical scalpel, tags were implanted into the body cavity via a small incision made in the belly. PIT tags were cleaned with rubbing alcohol and dried before being placed into each fish. The goal of this research was to determine if large, adult bull trout released above the diversion structure were capable of navigating upstream through roughly one mile of shallow, ditched channel that had marginal cover and resting places. In 2011 and 2012, the antenna array for detecting PIT tags was placed approximately 0.7 miles upstream of the diversion structure near the upper end of the ditched channel. In 2013 it was placed approximately 1.4 miles upstream of it in a natural portion of the channel. The antenna array and pit tag reader was powered by a 115 amp-hour, 12 volt marine-grade battery. The battery was switched out approximately twice per week in an attempt to maintain continuous reading capability. However, in all years, there were one or more short breaks in service at the station due to a failed battery.

RESULTS

Storm Lake Creek

Bull trout were captured and passed at the Silver Lake Diversion on Storm Lake Creek annually from 2010 through 2015. The vast majority of fish were captured in late July and early to mid August. Table 1 contains a summary of all fish collected at the site during each sample year. Through 2015, a total of 92 bull trout were passed over the diversion. Of these fish, 61 were 400 mm in length or larger.

Table 1. Data from fish collected below the Silver Lake Diversion on Storm Lake Creek from 2010 through 2015. Trout species in the table are as follows: BULL=Bull Trout, EB=Brook Trout, EBxBULL=Brook Trout/Bull Trout Hybrid, RB=Rainbow Trout, RBxWCT=Rainbow Trout/Westslope Cutthroat Trout Hybrid, WCT=Westslope Cutthroat Trout.

Year	Trout Species	Total Number Captured	Mean Length (mm)	Length Range (mm)
2010	BULL	17	462	192-570
	EB	3	64	54-74
	EBxBULL	1	157	-
	RBxWCT	1	290	-
	WCT	2	-	203-411
2011	BULL	9	445	186-540
	EBxBULL	1	254	-
	RB	5	408	266-487
	RBxWCT	4	429	397-460
	WCT	6	400	272-466
2012	BULL	28	277	146-529
	EB	8	131	86-238
	EBxBULL	4	371	107-575
	RB	4	81	44-174
	RBxWCT	1	110	-
	WCT	11	123	45-250

2013	BULL	9	463	170-585
	EB	36	64	43-344
	EBxBULL	7	326	168-565
	RB	1	128	-
	RBxWCT	2	-	95-160
	WCT	11	125	58-272
2014	BULL	14	385	150-603
	EB	10	164	118-285
	EBxBULL	11	450	165-651
	RB	1	270	-
	WCT	9	180	95-268
2015	BULL	15	479	199-589
	EB	1	386	-
	EBxBULL	5	469	388-544
	WCT	1	239	-

The PIT tag study conducted from 2011 through 2013 on bull trout captured below the diversion on Storm Lake Creek showed that it was possible for large, adult bull trout from Silver Lake to migrate up the channelized segment of lower Storm Lake Creek. However, the results also indicated there may still be issues for some fish, especially in years when flows are low. In 2011, a total of eight adult bull trout were PIT tagged (Table 2). Of these fish, only three passed by the antenna array located 0.7 miles upstream. Little if any spawning habitat occurs downstream of this location so it is unlikely that fish might have spawned downstream of the antenna array. It is more likely that the fish did not successfully migrate though the channelized reach and/or chose to return to Silver Lake. There's also a chance that fish swam through the pit tag reader undetected or when it was down because of battery failure. However, early testing showed the antenna array was very efficient at reading tags even traveling at fast rates of speed, and the down time of the reader was fairly minimal in all years. In 2012, an additional eight adult bull trout were tagged and released at the diversion location (Table 3). All but one of these fish passed by the station, which was again located 0.7 miles upstream of the diversion. Additionally, two of the fish were documented passing back by the station in late September, presumably returning to Silver Lake to overwinter. In 2013, only six adult bull trout were PIT tagged and only one of these fish passed by the antenna array (Table 4). Flows in Storm Lake Creek were very low in 2013 at the time bull trout were being passed over the diversion. Many of the riffles in the channelized portion of the stream required fish to swim through with their backs exposed to air. This was especially true for riffles just upstream of the diversion. Because of this, several of the fish captured below the diversion in 2013 were released farther upstream to avoid some of the most troublesome spots. The farthest upstream a fish was released was 0.55 miles above the diversion. The PIT tag reader was located 1.4 miles upstream of the diversion in 2013. The location was moved upstream from previous years to see if fish were migrating this far up the channel. Some limited spawning habitat does exist in between the two antenna sites, but a redd survey completed in 2013 did not indicate that fish spawned in this area. It is more likely that most fish failed to negotiate the channelized portion of lower Storm Lake Creek due to low flows and marginal habitat.

Table 2. Data from eight PIT tagged bull trout captured and passed at the Silver Lake Diversion on Storm Lake Creek during 2011. All fish were passed immediately above the diversion located near the mouth of the stream. The PIT tag reader was located approximately 0.7 miles upstream of the diversion.

Fish ID (PIT #)	Length (mm)	Weight (g)	Date Tagged and Passed	Activity Notes
165717283	283	205	8/09/2011	No further activity recorded.
165717280	479	943	8/11/2011	Went by PIT reader on 8/20 @ 16:57.
165717286	515	1266	8/15/2011	Recaptured below diversion on 10/3.
165717284	540	1386	8/15/2011	Recaptured below diversion on 10/3.
165717288	502	1122	8/15/2011	Recaptured below diversion on 8/25 and again on 9/1. Went by PIT reader on 9/13 @ 22:44.
165717281	500	1072	8/15/2011	No further activity recorded.
165717285	517	1058	8/22/2011	No further activity recorded.
165717290	487	898	8/25/2011	Recaptured below diversion on 9/1. Went by PIT reader on 9/17 @ 17:20.

Table 3. Data from eight PIT tagged bull trout captured and passed at the Silver Lake Diversion on Storm Lake Creek during 2012. All fish were passed immediately above the diversion located near the mouth of the stream. The PIT tag reader was located approximately 0.7 miles upstream of the diversion.

Fish ID (PIT #)	Length (mm)	Weight (g)	Date Tagged and Passed	Activity Notes
165717324	435	590	8/20/2012	Went by PIT reader on 8/26 @ 16:20.
165717289	529	1266	8/20/2012	Went by PIT reader on 9/23 @ 14:37.
165717309	513	1167	8/20/2012	Went by PIT reader on 8/20 @ 18:44 (~ 6.5 hours post release).
165717346	517	1288	8/20/2012	Went by PIT reader on 8/20 @ 19:18 (~ 7 hours post release). Went back by PIT reader on 9/18 @ 02:14.
165717326	491	965	8/23/2012	Went by PIT reader on 8/26 @ 20:18.
165717307	523	1087	8/23/2012	No further activity recorded.
165717304	490	1032	8/27/2012	Went by PIT reader on 8/27 @ 23:22 (~ 13 hours post release). Went back by PIT reader on 9/28 @ 02:11.
165717316	431	647	8/30/2012	Went by PIT reader on 8/31 @ 23:22 (~ 17 hours post release).

Table 4. Data from six PIT tagged bull trout captured and passed at the Silver Lake Diversion on Storm Lake Creek during 2013. Due to low flows, fish were passed in varying locations above the diversion located near the mouth of the stream. The farthest upstream a fish was released was approximately 0.55 miles. The PIT tag reader was located approximately 1.4 miles upstream of the diversion in 2013.

Fish ID (PIT #)	Length (mm)	Weight (g)	Date Tagged and Passed	Activity Notes
165717312	432	776	7/25/2013	Released immediately above diversion. No further activity recorded.
165717287	580	1536	7/29/2013	Released immediately above diversion. No further activity recorded.
165717338	585	1702	8/1/2013	Released 0.25 miles above diversion. No further activity recorded.
165717327	573	1750	8/1/2013	Released 0.25 miles above diversion. Went by PIT reader on 8/3 @ 19:02.
165717318	415	660	8/5/2013	Released 0.55 miles above diversion. No further activity recorded.
165717342	396	541	8/19/2013	Released immediately above diversion. No further activity recorded.

Twin Lakes Creek

Bull trout were captured and passed at the Silver Lake Diversion on Twin Lakes Creek annually from 2013 through 2015. Single sampling events were also completed in 2010 and 2011, but no bull trout were observed during those limited efforts. Sample conditions in 2015 were challenging for capturing fish below the diversion and likely limited the success of passing bull trout in that year. Due to issues with a leaking head gate on the pipeline to Silver Lake, BSB did not spill water over the dam as was typical. Instead, the small reservoir behind the dam was drawn down and water was run through an old wooden bypass flume. This flume emptied into a large, deep pool that proved extremely difficult to sample.

The majority of bull trout captured below the Silver Lake Diversion on Twin Lakes Creek from 2013 through 2015 were collected during the month of August. Table 5 contains a summary of all fish collected during each of the sample years. Through 2015, a total of 15 bull trout were captured below the diversion, 13 of which were passed over the structure. Of these passed fish, five were 400 mm in length or larger.

Table 5. Data from fish collected below the Silver Lake Diversion on Twin Lakes Creek from 2013 through 2015. Trout species in the table are as follows: BULL=Bull Trout, EB=Brook Trout, EBxBULL=Brook Trout/Bull Trout Hybrid, WCT=Westslope Cutthroat Trout.

Year	Trout Species	Total Number Captured	Mean Length (mm)	Length Range (mm)
2013	BULL	7	355	219-542
	EB	20	186	100-268
	EBxBULL	1	277	-
	WCT	93	182	76-296
2014	BULL	6	456	284-635
	EB	4	159	94-182
	EBxBULL	3	310	244-426
	WCT	54	202	86-387
2015	BULL	2	202	180-224
	EB	7	151	106-195
	EBxBULL	1	378	-
	WCT	32	148	41-221

Warm Springs Creek

Bull trout were captured and passed at Meyer's Dam on Warm Springs Creek annually from 2012 through 2015. Most of the bull trout captured at the site were collected during the month of August. Table 6 contains a summary of all fish collected during each of the sample years. Through 2015, a total of 11 bull trout were captured below the diversion and passed over it. Of these passed fish, four were 400 mm in length or larger.

Table 6. Data from fish collected below Meyer's Dam on Warm Springs Creek from 2012 through 2015. Only bull trout were targeted in 2012. Trout species in the table are as follows: BULL=Bull Trout, EB=Brook Trout, EBxBULL=Brook Trout/Bull Trout Hybrid, LL=Brown Trout, RB=Rainbow Trout, RBxWCT=Rainbow Trout/Westslope Cutthroat Trout Hybrid, WCT=Westslope Cutthroat Trout.

Year	Trout Species	Total Number Captured	Mean Length (mm)	Length Range (mm)
2012	BULL	3	272	210-318
2013	BULL	2	-	280-477
	EB	7	182	117-262
	LL	35	243	122-369
	RB	5	183	130-353
	RBxWCT	3	146	131-171
	WCT	2	-	120-229
2014	BULL	3	415	395-426
	LL	12	271	127-419
2015	BULL	3	327	205-564
	EB	5	149	123-180
	EBxBULL	1	532	-
	LL	61	201	113-332
	RBxWCT	4	217	184-300

DISCUSSION

The work summarized in this report indicates that several of the structures associated with the Silver Lake Water System have direct impacts to the spawning and migratory patterns of bull trout in the Warm Springs Creek drainage. Sampling below three System diversions on Storm Lake Creek, Twin Lakes Creek and Warm Springs Creek found bull trout to be present below all of the structures during the typical spawning period for the species. Addressing fish passage concerns at these sites should be a priority from a native species conservation standpoint. Passage structures with nature-like features should be constructed at each of the three diversions summarized in this report. Additional investigations regarding other water system infrastructure should also be examined for the ability to improve fish passage. This includes the channelized reach of lower Storm Lake Creek were pool habitat and cover is limited.

In order to avoid unintended impacts to the fish community in the drainage, it is recommended that non-volitional passage structures be constructed at Meyer's Dam on Warm Springs Creek

and at the Silver Lake Diversion on Twin Lakes Creek. These structures should allow fish to be trapped and manually sorted such that only species of interest can be passed. Managing these types of structures will require a time and personnel commitment during critical migratory periods.

LITERATURE CITED

Dehaan, P. and L. Godfrey. 2010. Bull Trout Population Genetic Structure and Entrainment in Warm Springs Creek, Montana. United States Fish and Wildlife Service Report. Abernathy Fish Technology Center. Longview, WA.