Fish Population Monitoring in Silver Bow Creek, Montana

2012

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Introduction

Historically, sampling of fish in Silver Bow Creek was very limited because of the extremely harsh environment and the perceived absence of fish. In 2002, Montana Fish, Wildlife and Parks (FWP), Montana Department of Environmental Quality (DEQ), and the Montana Natural Resource Damage Program (NRDP) believed it was important to initiate fish sampling because of the potential for improved water quality associated with remediation and restoration activities of the Streamside Tailings Operable Unit (SSTOU) in Silver Bow Creek. Presumably, improved water quality resulting from tailings removal along Silver Bow Creek will provide conditions that will allow fish to survive and complete life-history cycles to sustain a fishery. Fish sampling began in 2002 to monitor and document fish response to ongoing remediation activities. The sampling effort was expanded by adding new electrofishing sections during 2005 and 2008 to provide better understanding of fishery trends observed during previous sampling years.

Methods

Two electrofishing study sections were sampled in Silver Bow Creek during 2002 to determine the presence or absence of fish in Silver Bow Creek near Butte, Montana. One section was located upstream of Rocker and one section was located immediately upstream of Montana Avenue in Butte. During 2003 and 2004, three electrofishing study sections were sampled in Silver Bow Creek. The sections were located near Rocker, Ramsay and below the confluence of German Gulch. The upper-most electrofishing section above Montana Street in Butte was not repeated after 2002.

Due to stream channel remediation activities in the Ramsay Area during 2005, the Ramsay Section was replaced with two sections: Reach F (above Ramsay) and Miles Crossing (below Ramsay). The Rocker Section and Below German Gulch Sections were not changed from previous years. Two additional sections were added in 2005 upstream of the sewage treatment outfall near Butte to provide an improved perspective of the longitudinal distribution of fish species in the upper Silver Bow Creek drainage. One section was located in Lower Area One (LAO) and the uppermost section was located near Father Sheehan Park.

During 2006, four of the previously established electrofishing sections were sampled. These included the LAO Section, Rocker Section, Ramsay Section, and Below German Gulch Section. These sites were also sampled in 2007, but in addition, the Father Sheehan Section was also surveyed. In 2008, all of the sections sampled in 2007 were again surveyed, and an additional section was added upstream of the Highway 1 crossing near Opportunity. From 2009 through 2012, all of the sections that were monitored in 2008 were again sampled. Figure 1 shows a map of the study area including locations of current fish sampling sections. Appendix 1 provides a description of all current sites sampled in Silver Bow Creek.

At all sections during all years, catch-per-unit-effort sampling of fish was conducted using a backpack electrofishing unit (LR-24 Electrofisher manufactured by Smith Root, Inc.). Generally, a single upstream pass was conducted by a two or three-person crew. At a few sites, multiple upstream passes were made to obtain an estimate of capture efficiency. The entire channel was sampled at all sections and one or two netters captured all observable fish. Fish were held until each pass was completed and all fish were measured to the nearest millimeter and released. Section lengths were documented and

time of electrofishing was recorded from the internal timer of the electrofisher to provide measures of sampling effort.

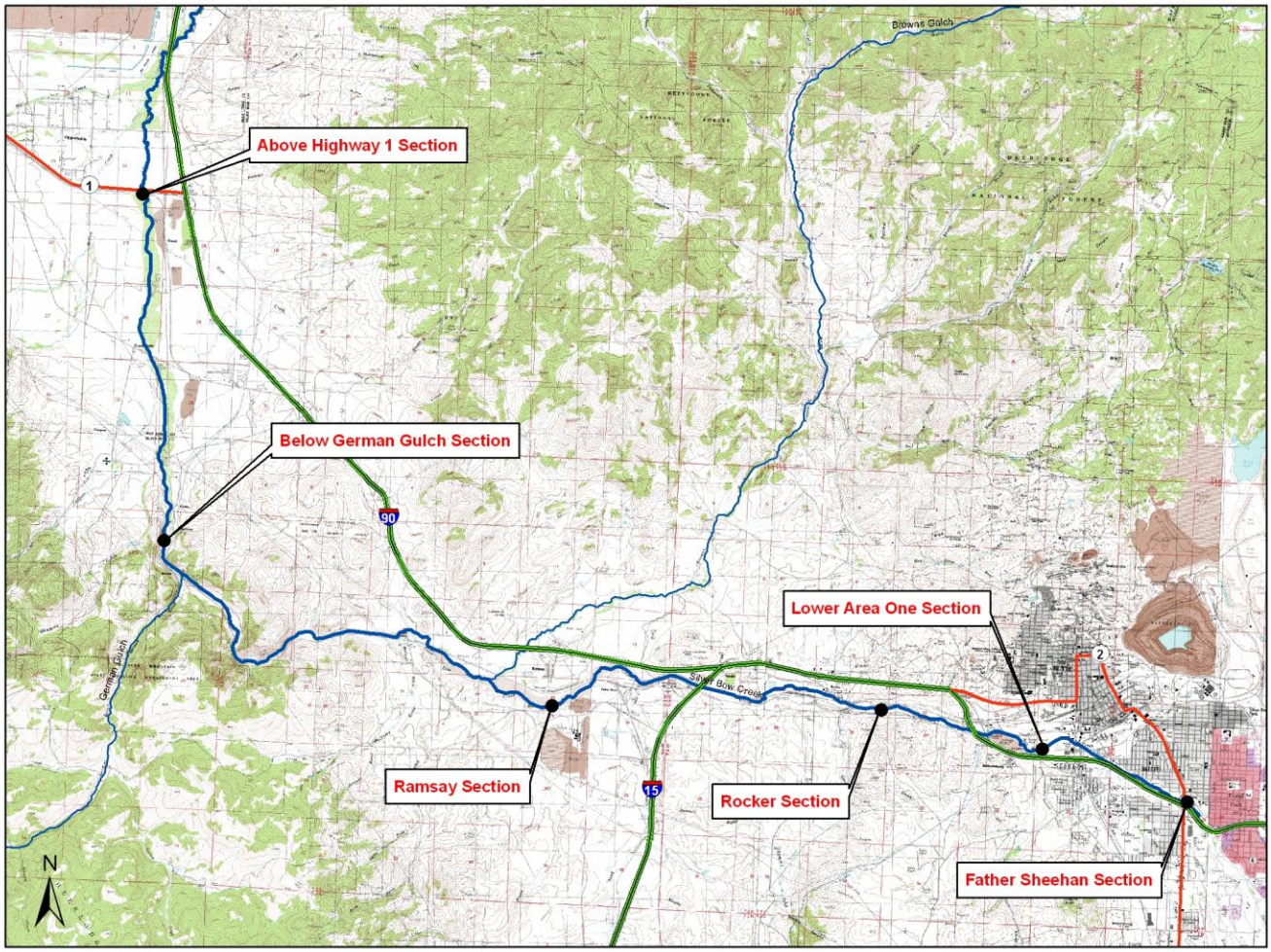

Figure 1. Map of the Silver Bow Creek study area.

Results

General:

Fish sampling results from 2002 through 2012 have primarily consisted of determining the presence or absence of a fish species, an estimate of number of fish per 100 seconds of electrofishing effort also known as Catch-Per-Unit-Effort (CPUE), and basic size structure of fish captured. This level of effort is appropriate for determining fishery trends relating water quality issues to fishery levels, and assessing fishery improvements due to ongoing remediation and restoration activities. Appendix 2 contains a table of catch-per-unit-effort values for all sample sections from 2002-2012.

Fish species composition and abundance in Silver Bow Creek varies throughout the sections sampled from 2002 through 2012. Table 1 shows species presence and general abundance in various portions of the watershed as of 2012 for westslope cutthroat trout (*Oncorhynchus clarki lewisi*), brook trout (*Salvelinus fontinalis*), rainbow trout (*Oncorhynchus mykiss*), longnose sucker (*Catostomus catostomus*), slimy sculpin (*Cottus cognatus*), and central mudminnow (*Umbra limi*). These represent all of the species that are known to occur in Silver Bow Creek. Westslope cutthroat trout, longnose sucker and slimy sculpin are native to the watershed while brook trout, rainbow trout, and central mudminnow are present due to introductions. Brown trout (*Salmo trutta*) (introduced species) occur downstream of Silver Bow Creek at the Warm Springs Ponds. However, to date, this species has not been captured during routine sampling efforts in the survey reaches of Silver Bow Creek.

Table 1. Fish species presence/absence and general rating of abundance in the upper Silver Bow Creek watershed as of 2012. A = abundant, C = common, P = present, R = rare, NP = not present. Species abbreviations: WCT = Westslope Cutthroat Trout, EB = Brook Trout, RB = Rainbow Trout (or phenotypic hybrid), LN SU = Longnose Sucker, SL COT = Slimy Sculpin, CM MN = Central Mudminnow.

	FISH SPECIES					
LOCATION	**WCT**	**EB**	**RB**	**LN SU**	**SL COT**	**CM MN**
Headwater Tributaries	C	C	NP	R	R	R
Silver Bow Creek – Butte Area (Father Sheehan Park)	R	C	NP	C	C	P
Silver Bow Creek- Remediated Area Above Sewage Outfall (LAO)	R	R	NP	C	C	P
Silver Bow Creek - Remediated Area Below Sewage Outfall (Rocker)	P	P	NP	A	R	R
Silver Bow Creek – Remediated Area Near (Ramsay/Miles Crossing)	P	P	NP	P	R	R
Silver Bow Creek – Below Remediated Area Downstream of German Gulch	P	P	R	P	P	NP
Silver Bow Creek – Below Remediated Area – Above Hwy. 1 Near Opportunity	R	R	P	P	P	NP

A general trend in fish species composition indicates that trout species, which are considered to be relatively sensitive to poor water quality, are mostly limited to upstream reaches of Silver Bow Creek and tributaries of Silver Bow Creek (Table 1). Based on the limited number captured during fall

sampling, trout occur in relatively low densities in mainstem Silver Bow Creek from approximately Butte to Warm Springs Ponds. Fall sampling from 2007 through 2012 has started to show limited numbers of trout in places where they previously had not been documented (e.g. Ramsay and Rocker Sections).

More tolerant species such as longnose sucker and slimy sculpin are present in most electrofishing sections of Silver Bow Creek at variable densities (Table 1). Suckers tend to be most abundant near the Rocker Section but are still fairly common both up and downstream from this site. Sculpin tend to be most abundant near Butte and become less abundant at downstream sites. Central mudminnow are dispersed throughout Silver Bow Creek from approximately Butte to Ramsay, but are most abundant near Butte.

2012 Sampling:

Six electrofishing sections were surveyed between October 11th and 12th, 2012. Sections sampled included Father Sheehan, Lower Area One, Rocker, Ramsay, Below German Gulch, and Above Highway 1 Bridge. All sections except the German Gulch Section were sampled on October 11th. The German Gulch Section was sampled on October 12th due to flow and turbidity issues associated with upstream remediation work that was present in the section on October 11th. Table 2 contains catch-per-unit-effort values from all of the sections sampled. See Appendix 2 for a summary of catch-per-unit-effort for all sections sampled from 2002-2012.

At the Father Sheehan Section, one electrofishing pass was made through the 200-meter section. In this pass, 256 brook trout (Mean Length: 156 mm, Range: 71-401 mm), seven longnose sucker (Mean Length: 76 mm, Range: 36-200 mm), 52 slimy sculpin, and one central mudminnow were captured during 2170 seconds of electrofishing. Similar to previous years, brook trout were present in relatively high density (Table 2, Appendix 2), and many of the fish captured were large adults that were ready to spawn. As stated in previous reports, this reach of the stream is an important spawning location for brook trout in upper Silver Bow Creek and lower Blacktail Creek. Longnose sucker density continued to be rather low in the Father Sheehan Section in 2012, as did central mudminnow density. Central mudminnow catch-per-unit-effort showed a decline for the sixth straight year. The continued decline in abundance of this nonnative species is not well understood, but may be due to the high trout density in the section. It is likely that brook trout compete with and prey on central mudminnow. Sculpin continued to be rather common in the Father Sheehan Section in 2012, with catch-per-unit-effort being similar to previous years (Appendix 2).

At Lower Area One, the historic electrofishing section was found to be completely impounded by beaver dams. Because of the abundance of deepwater habitat the original section was not able to be sampled. Subsequently, the section was moved downstream slightly to a reach less impacted by beaver activity. One 2140-second electrofishing pass was made through the new 1000-foot sample section. This sampling effort yielded seven brook trout (Mean Length: 275 mm, Range: 140-355 mm), 54 longnose sucker (Length: 96 mm), and 99 slimy sculpin. The brook trout catch appeared to be similar to previous years although catch-per-unit-effort was down from the most recent two years. (Table 2, Appendix 2). Sucker and sculpin density rose markedly in 2012 to numbers not seen for several years (Table 2, Appendix 2). It is unknown what caused the apparent increase in density of these two species, but possible explanations could be that they preferred the habitat in the un-impounded reach where the new

section was located, or that the general lack of deepwater habitats in the new section made electrofishing more efficient (i.e. increased capture efficiency of fish in the section).

At the Rocker Section, one 2586-second electrofishing pass collected 562 longnose suckers (Mean Length: 130 mm, Range: 45-293 mm) and eight slimy sculpin. No trout were collected in the section in 2012. Trout were first documented in the Rocker Section during fall sampling in 2010 and were again present in 2011 (Appendix 2). Density of trout tended to be low in both years, however (Appendix 2). While sucker density has been relatively high in the Rocker Section over the last several years, 2012 was an all time high for the species (Appendix 2). The high densities witnessed in 2012 could possibly be related to the above average flows observed throughout much of 2011 that led to an increase in spawning success. Many of the suckers sampled appeared to be approximately one year old based on the analysis of a length-frequency distribution.

At the Ramsay Section, one 1329-second electrofishing pass was made through the 1000-foot sample reach. The continued presence of westslope cutthroat trout in the section was the most notable finding (Table 2). The survey turned up eight cutthroat trout (Mean Length: 321 mm, Range: 276-377 mm). This species has continued to have a presence in the Ramsay Section during fall sampling since it was first documented in 2008 (Appendix 2). While numbers have generally tended to increase annually in years prior, we witnessed a slight drop-off in 2012 (Appendix 2). However, it is important to note that overall numbers have been relatively low in all years and slight differences should not be over-analyzed. Electrofishing in the Ramsay Section in 2012 also turned up ten longnose suckers (Mean Length: 92 mm, Range: 42-190 mm) and one slimy sculpin. Fish density continues to be low in the Ramsay Section despite this stream reach having been remediated in 2005.

At the German Gulch Section, 3093 seconds of electrofishing turned up some of the highest densities of fish ever recorded in the sample reach (Table 2, Appendix 2). Among these were 29 westslope cutthroat trout (Mean Length: 272 mm, Range: 65-415 mm), 20 brook trout (Mean Length: 104 mm, Range: 83-154 mm), 25 longnose suckers (Mean Length: 84 mm, Range: 46-168 mm), and 70 slimy sculpin. Westslope cutthroat trout density was the highest on record, while brook trout density appeared similar to the previous year. Sucker and sculpin density appeared to be up over the previous year, with sculpin numbers being the highest ever recorded in the section. Despite several fish species being more common than in any previous sample year, it is important to note that overall fish density in the reach was still relatively low. The German Gulch section remained un-remediated at the time of sampling in 2012.

Remediation activities in 2012 completely obliterated the section above the Highway 1 crossing near Opportunity that was established in 2008. Because of this, a new 325-meter section was measured out within the recently constructed channel. Sampling in this newly established section turned up one rainbow trout (Length: 138 mm), four brook trout (Mean Length: 209 mm, Range: 151-281 mm), one juvenile longnose sucker and 22 slimy sculpin. The single electrofishing pass through the section took 1222 seconds. Despite being recently remediated, fish density at the site was similar to past years and continued to be very low.

Table 2. Catch-per-unit-effort for species sampled in six sections of Silver Bow Creek, October 2012.

Section	Species	# Per 100 Seconds of Effort
Father Sheehan	Brook Trout	11.80
	Longnose Sucker	0.32
	Sculpin	2.40
	Central Mudminnow	0.05
Lower Area One	Brook Trout	0.33
	Longnose Sucker	2.52
	Sculpin	4.63
Rocker	Longnose Sucker	21.73
	Sculpin	0.31
Ramsay	Westslope Cutthroat Trout	0.60
	Longnose Sucker	0.75
	Sculpin	0.08
Below German Gulch	Westslope Cutthroat Trout	0.94
	Brook Trout	0.65
	Longnose Sucker	0.81
	Sculpin	2.26
Above Highway 1 Bridge	Rainbow Trout	0.08
	Brook Trout	0.33
	Longnose Sucker	0.08
	Sculpin	1.80

Daily streamflow in Silver Bow Creek during October 2012 sampling (October 11th) was 17 cfs at the USGS gauge station below Blacktail Creek, and was 31 cfs at the USGS gauge station at Opportunity. In general, 2012 was a relatively low water year for Silver Bow Creek. Mean monthly flow in the stream below Blacktail Creek was highest during April at 39.0 cfs, which was about 10 cfs higher than the period-of-record (POR) average for the same month (POR ~ 29 cfs). Typically, June is the highest flow month in Silver Bow Creek. In 2012 mean monthly flow in June below Blacktail Creek was only 25.5 cfs. This was about 10.5 cfs below the POR average. Although all USGS flow data was not published for the year at the time this report was written, mean monthly flow appeared lowest at the USGS gauge station below Blacktail Creek during August at 15.3 cfs. The POR average flow for this location and month is 19 cfs. Mean monthly flow at the USGS gauge station at Opportunity was also highest in April at approximately 97 cfs. While this was about 31 cfs higher than the period-of-record average (POR ~ 66 cfs), it was uncharacteristic for the site as flows typically peak in May and June at this station. Mean monthly flow at this site also appeared lowest in August at approximately 18.9 cfs; 9.1 cfs below the POR average for the same month.

Water temperature was monitored at four locations along Silver Bow Creek, as well at one location in lower Blacktail Creek, through the summer of 2012. In Silver Bow Creek, the monitoring sites were located above Rocker, at Miles Crossing, below German Gulch, and near Opportunity. In Blacktail Creek, the site was situated within Father Sheehan Park above the confluence with Basin Creek. All thermographs were operated from June 7 through October 14. At the lower Blacktail Creek site, daily high temperature exceeded 15°C on 70 days, but on only one day did temperature rise above 20°C. The maximum daily temperature at this site was 20.46°C recorded on July 17. In Silver Bow Creek, at the site above Rocker, maximum daily water temperature exceeded 15°C on 91 days, but 20°C on only 11 days. The maximum-recorded temperature at this site was 21.0°C on July 9. At Miles Crossing, maximum daily temperature exceeded 15°C on 113 days including 55 days in which it exceeded 20°C. The maximum-recorded temperature was 25.1°C on August 12. At the site below German Gulch, maximum daily temperature exceeded 15°C on 89 days, and 20°C on 45 days. Maximum-recorded temperature at this site was 23.6°C on July 21. Near Opportunity, daily high temperatures exceeded 15°C on 112 days, and 20°C on 60 days. The maximum daily temperature at this site was 24.4°C recorded on July 21 and July 29.

Discussion

Prior to 2002, fish sampling in the upper Silver Bow Creek watershed was primarily confined to tributaries such as Blacktail Creek and German Gulch. Silver Bow Creek was generally considered to be void of fish except for occasional observations of suckers during the late 1990's when remediation of the stream channel began. Sampling described in this report represents the first formal sampling of fish presence and abundance in Silver Bow Creek. Fish sampling was conducted to provide a general perspective of fish response to ongoing remediation activities in Silver Bow Creek. Since sections were sampled using relatively low effort sampling techniques, interpretation of results should be limited to observations of major trends in fish species composition and abundance. Sampling conducted in this effort is sufficient to determine if a sampling reach was fishless for one or more years, followed by colonization by tolerant species such as suckers and sculpin, and then followed by colonization by sensitive species such as trout. Fluctuations in fish abundance or species composition at specific sampling locations should not be considered overly significant unless a large change or multi-year trend is observed.

The presence or absence of various fish species among the sample sections in Silver Bow Creek provides insight into changes in water quality along the longitudinal gradient of the stream. Because of their sensitivity to poor water quality, trout are good to examine for distributional changes over time. Brook trout are common in upper Silver Bow Creek at Father Sheehan Park as well as in German Gulch and Browns Gulch. Fish in each of these areas have access to downstream reaches of Silver Bow Creek that provide relatively similar physical habitat types. However, prior to 2007, no brook trout were captured during fall sampling in sections downstream of Father Sheehan Park (e.g. Lower Area One, Rocker, and Ramsay), except for one individual captured below the confluence of German Gulch in 2006. It can be reasonably assumed that water quality deterioration downstream of Father Sheehan Park was the primary reason for the absence or rarity of trout in downstream reaches of Silver Bow Creek. In fall 2007, brook trout were found in two reaches where they had previously not been documented. Three brook trout were captured at the Lower Area One Section, and one brook trout was captured at the

Ramsay section. Since 2007, brook trout have been documented in at least one or more sampling years at all of the current sampling sections. While this is an improvement over the past, fish density downstream of Butte still continues to be low.

In addition to brook trout, native westslope cutthroat trout are also beginning to be detected with relative frequency in Silver Bow Creek. Westslope cutthroat trout are most common in German Gulch, but also occur in relatively low densities in upper Browns Gulch as well as upper Blacktail Creek. Prior to 2008 westslope cutthroat trout had only been observed in Silver Bow Creek just downstream of German Gulch. And, the first fall presence of the species in this area was not described until 2007. In 2008, one of the most interesting findings of the fall monitoring was the appearance of westslope cutthroat trout in the Ramsay Section. While it was only two individuals, both were relatively large in size. In 2009, westslope cutthroat trout continued to be present in the Ramsay section (4 individuals were collected), and a single individual was also captured in the Lower Area One Section. In 2010 and 2011, westslope cutthroat trout were present in a majority of the sections sampled, including the Rocker Section where trout were not observed until 2010. In 2012 the species was only found in the sections below German Gulch and at Ramsay. It is likely that lower than average flows, high summer water temperatures and other water quality concerns limited the use of mainstem Silver Bow Creek by cutthroat trout for much of the summer and early fall. While westslope cutthroat trout density remains relatively low throughout Silver Bow Creek, the continued presence of this species is indeed a positive sign.

While the continued presence or appearance of trout in all of the current monitoring sections in Silver Bow Creek is an improvement over past years when no fish could be detected, the rarity of these species still suggests water quality remains a concern downstream of Butte. At the Rocker Section, water quality is impaired by several factors including elevated ammonia levels directly related to the Butte wastewater treatment plant discharge located just upstream. Wastewater discharged directly into Silver Bow Creek from this facility has very high ammonia concentrations and as this ammonia reaches the stream, microbial oxidation creates a reach with limited available oxygen, especially during the summer months. The longitudinal and temporal extent of this condition and its effects on fish species composition and abundance is not completely clear. However, within the Rocker Section itself, it is quite apparent that wastewater discharge is affecting the fish community at this site. Although fall sampling in 2010 and 2011 detected trout in the Rocker Section, it should not lessen the significance of the impacts the Butte wastewater treatment plant has on the fish community of upper Silver Bow Creek. Longnose suckers continue to dominate the fish assemblage at this site. Sucker species tend to be more tolerant of a variety of pollutants such as metals, nutrients, low dissolved oxygen, high sediment loading, and elevated water temperatures. It is unlikely we will witness a significant improvement in the health of the fishery of upper Silver Bow Creek until the discharge of the Butte wastewater treatment plant is addressed.

Perhaps one of the most interesting sections that we currently monitor in Silver Bow Creek is the Ramsay Section. This section was remediated in 2005 and has now been cleaned up for approximately 7 years. Prior to being remediated, fish sampling in 2003 and 2004 found no fish present. However, in 2006 (post remediation), longnose suckers were found to have colonized the reach and were in fact, relatively common. Since then, sucker density has continued to decline to the point that in the last several years, only a few juveniles and young-of-the-year were collected during fall sampling. In contrast, westslope cutthroat trout have begun to colonize the reach, and have been found in the section every year since 2008, with a few more fish being found each year prior to 2012. Despite this, fish densities in this reach are still extremely low. The reason for this is not completely clear. While it is

likely that downstream impacts of the wastewater discharge in Butte continue to impact this segment of Silver Bow Creek, it is unknown why longnose suckers continue to be so rare when they are very common in the Rocker Section, which is closer to the discharge point. Another factor that may help to describe fish distribution patterns at the Ramsay section is summer stream temperature. Temperature monitoring over the last several years in Silver Bow Creek above Rocker and at Miles Crossing (just below the Ramsay Section) showed noticeable differences in the two reaches in terms of the number of days stream temperature rose above 20º C, a value often considered to be near the upper limit tolerated by many trout species. Typically, stream temperatures in excess of 20º C are stressful and potentially deadly to trout and other coldwater fish species. During the last three summers, maximum daily stream temperatures only rose above 20º C an average of five days at the Rocker section. However, farther downstream at Miles Crossing (near the Ramsay Section), stream temperature rose above 20º C an average of 43 days. Prolonged exposure to high stream temperatures in conjunction with low oxygen levels created by the nitrification of ammonia, may be leading to increased fish mortality or avoidance in this reach during the summer months.

In short, it is clear that there are multiple factors affecting fish use and survival in Silver Bow Creek. Only continued monitoring and more in-depth research will begin to answer some of these questions.

Recommendations and Additional Studies

Continued monitoring of the established electrofishing sections in Silver Bow Creek remains one of the best ways to assess fish response to ongoing remediation and restoration efforts as well as other factors such as drought and nutrient loading. Fish sampling in the Rocker, Ramsay and Below German Gulch Sections should be repeated annually, and sampling at the sections added in 2005 at Father Sheehan Park and at Lower Area One should also be continued. Additionally, adding and repeating new sample sections downstream of German Gulch such as the one above the Highway 1 crossing near Opportunity (added in 2008) will be necessary as remediation activities continue to move downstream.

Seasonal fish movements throughout the Silver Bow Creek watershed may result in problems interpreting trends with fish populations. Electrofishing surveys during the fall provide a snapshot of the fishery status during a specific point in time, but fish mortality during one season may be masked by fish migration during another. A fish tagging and movement study would provide beneficial information on how fish are utilizing and moving in the Silver Bow Creek watershed. A study of this sort began in the summer of 2009. A graduate student from Montana State University (Joe Naughton) conducted the study with assistance from Montana Fish, Wildlife and Parks and the Natural Resource Damage Program. During this study, several thousand fish (including brook trout, westslope cutthroat trout, and longnose suckers) were tagged with passive integrated transponder (PIT) tags, and multiple antenna stations were set up to record fish movement. Fish were collected and tagged in the mainstem of Silver Bow Creek from below German Gulch all the way upstream to the confluence with Blacktail Creek. Additionally, a number of fish were tagged in the lower reaches of the more significant tributaries such as German Gulch, Browns Gulch, and Blacktail Creek. The summarization of this research is almost complete and should provide a very valuable piece of information related to fish behavior in the Silver Bow Creek watershed.

In addition to the graduate research project discussed above. Montana Fish, Wildlife and Parks initiated a small-scale radio-telemetry project in the spring of 2012. We captured and radio-tagged 20 adult westslope cutthroat trout from the mainstem of Silver Bow Creek between Rocker and Miles Crossing. We have since followed the movements of these fish on a weekly basis. One thing we have learned is that mortality of fish in the mainstem of Silver Bow Creek appears to be high. Many of the fish tagged died at some point after tagging. While several of these fish likely died due to post-tagging complications, others died from water quality issues and others from predation. One notable finding from the 2012 telemetry work was the movement of several fish into German Gulch to spawn. German Gulch has been the most used tributary by cutthroat trout during this study so far. Additionally, the telemetry study as well as our normal tributary monitoring work documented the use of lower German Gulch by high numbers of adult fish during the summer of 2012. It is likely that most of these fish were from Silver Bow Creek but sought thermal and oxygen refuge (cold and well oxygenated water) in lower German Gulch due to poor water quality conditions in mainstem Silver Bow Creek. The telemetry study is ongoing and will continue into 2013. We recovered many of the radio tags from fish that died during the study in 2012 and plan to put these tags into new fish in the spring of 2013. Results of this study will likely not be summarized until after it is fully completed.

Appendices

Appendix 1. Description of current fish sampling sections in Silver Bow Creek.

Father Sheehan Section – Above the SSTOU
Section Length: 200 m
Years Sampled: Fall 2005, 2007, 2008, 2009, 2010, 2011, 2012
GPS: N45.98524 W112.50719 (Bottom)

Lower Area One Section – Above the SSTOU
Section Length: 1000 ft
Years Sampled: Fall 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012*
GPS: N45.99489 W112.54819 (Bottom); N45.99550 W112.54564 (Top)
*GPS: N45.99606 W112.56037 (Bottom); N45.99533 W112.55781 (Top)

Rocker Section – Remediated in 2001
Section Length: 1000 ft
Years Sampled: Fall 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012
GPS: N46.00123 W112.59315 (Bottom); N46.00151 W112.58925 (Top)

Ramsay Section – Remediated in 2005
Section Length: Approx. 1000 ft
Years Sampled: Fall 2002, 2003, 2004, 2006, 2007, 2008, 2009, 2010, 2011, 2012
GPS: N46.00095 W112.68165 (Top)

Below German Gulch - Unremediated
Section Length: 1000 ft
Years Sampled: Fall 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012
Spring 2004, 2005, 2007
GPS: N46.02852 W112.79500 (Bottom); N46.02557 W112.79507 (Top)

Above Highway 1 Crossing – Remediated in 2012
Section Length: 250 m (2008-2011), 325 m (Current)
Years Sampled: 2008, 2009, 2010, 2011, 2012
GPS: N46.09510 W112.80492 (Bottom); N46.09378 W112.80405 (Top)

Appendix 2. Catch-Per-Unit-Effort values in number of fish per 100 seconds of electrofishing time for all species and sections sampled in Silver Bow Creek from 2002 through 2012. WCT = Westslope Cutthroat Trout, RB = Rainbow Trout, EB = Brook Trout, LN SU = Longnose Sucker, SL COT = Slimy Sculpin, CM MN = Central Mudminnow. (* denotes sections not part of the current monitoring program)

Section	Species	2002	2003	2004	2005	2006	2007	2008	2009	2010
Father Sheehan	WCT	n/a	n/a	n/a	0	n/a	0	0	0	0
	EB	n/a	n/a	n/a	1.9	n/a	2.33	3.59	5.88	6.46
	LN SU	n/a	n/a	n/a	1	n/a	2.15	0.51	0.07	0.68
	SL COT	n/a	n/a	n/a	3.8	n/a	4.85	3.59	2.58	1.87
	CM MN	n/a	n/a	n/a	0	n/a	1.42	0.68	0.43	0.28
Lower Area One	WCT	n/a	n/a	n/a	0	0	0	0	0.05	0
	EB	n/a	n/a	n/a	0	0	0.1	0	0.11	0.95
	LN SU	n/a	n/a	n/a	12	3.1	1.41	1.66	1.03	0.43
	SL COT	n/a	n/a	n/a	0.74	6.9	7.78	4.62	3.76	1.43
	CM MN	n/a	n/a	n/a	0.16	0.14	0.34	0.24	0.38	0
MT Avenue*	WCT	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	EB	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	LN SU	2.6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	SL COT	3.5	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
	CM MN	0.002	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Rocker	WCT	0	0	0	0	0	0	0	0	0.20
	EB	0	0	0	0	0	0	0	0	0
	LN SU	4.9	3	1.2	4.7	8.7	4.35	8.92	2.27	13.73
	SL COT	0.1	0.06	0.06	0	0.16	0.2	0	0.06	0.10
	CM MN	0	0	0	0	0	0	0	0	0
Above Ramsay*	WCT	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
	EB	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
	LN SU	n/a	n/a	n/a	5.5	n/a	n/a	n/a	n/a	n/a
	SL COT	n/a	n/a	n/a	0.08	n/a	n/a	n/a	n/a	n/a
	CM MN	n/a	n/a	n/a	0.04	n/a	n/a	n/a	n/a	n/a
Ramsay	WCT	n/a	0	0	n/a	0	0	0.13	0.29	0.52
	EB	n/a	0	0	n/a	0	0.05	0.06	0	0.06
	LN SU	n/a	0	0	n/a	7.2	2.01	2.02	0.50	0.26
	SL COT	n/a	0	0	n/a	0.1	0.14	0.32	0.07	0
	CM MN	n/a	0	0	n/a	0	0	0	0	0
Below Ramsay*	WCT	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
	EB	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
	LN SU	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
	SL COT	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
	CM MN	n/a	n/a	n/a	0	n/a	n/a	n/a	n/a	n/a
German G. - Fall	WCT(w/RB)	n/a	0	0	0	0	0.08	0.11	0.07	0.12
	EB	n/a	0	0	0	0.05	1.51	0.11	0.21	0.95
	LN SU	n/a	0	0	0.05	0.5	1.78	1.88	0.32	2.13
	SL COT	n/a	0	0	0.15	0.14	0.7	0.21	0	0.30
	CM MN	n/a	0	0	0	0	0	0	0	0
German G. - Spr.*	WCT	n/a	n/a	0.11	0	n/a	0.07	n/a	n/a	n/a
	EB	n/a	n/a	0.05	1.58	n/a	0.13	n/a	n/a	n/a
	LN SU	n/a	n/a	0.11	0	n/a	0.5	n/a	n/a	n/a
	SL COT	n/a	n/a	0	0.05	n/a	0.1	n/a	n/a	n/a
	CM MN	n/a	n/a	0	0	n/a	0.03	n/a	n/a	n/a
Above Hwy 1	RB	n/a	n/a	n/a	n/a	n/a	n/a	0.12	0.18	0.32
	WCT	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0.08
	EB	n/a	n/a	n/a	n/a	n/a	n/a	0	0.06	0
	LN SU	n/a	n/a	n/a	n/a	n/a	n/a	0.70	0.06	0
	SL COT	n/a	n/a	n/a	n/a	n/a	n/a	0.89	0.36	3.33
	CM MN	n/a	n/a	n/a	n/a	n/a	n/a	0	0	0

Appendix 2 - continued.

Section	Species	2011	2012
Father Sheehan	WCT	0	0
	EB	5.73	11.80
	LN SU	0.31	0.32
	SL COT	2.07	2.40
	CM MN	0.13	0.05
Lower Area One	WCT	0.07	0
	EB	0.73	0.33
	LN SU	0.07	2.52
	SL COT	0.20	4.63
	CM MN	0.07	0
MT Avenue*	WCT	n/a	n/a
	EB	n/a	n/a
	LN SU	n/a	n/a
	SL COT	n/a	n/a
	CM MN	n/a	n/a
Rocker	WCT	0.12	0
	EB	0.23	0
	LN SU	10.94	21.73
	SL COT	0	0.31
	CM MN	0	0
Above Ramsay*	WCT	n/a	n/a
	EB	n/a	n/a
	LN SU	n/a	n/a
	SL COT	n/a	n/a
	CM MN	n/a	n/a
Ramsay	WCT	1.04	0.60
	EB	0	0
	LN SU	0.38	0.75
	SL COT	0	0.08
	CM MN	0	0
Below Ramsay*	WCT	n/a	n/a
	EB	n/a	n/a
	LN SU	n/a	n/a
	SL COT	n/a	n/a
	CM MN	n/a	n/a
German G. - Fall	WCT(w/RB)	0.13	0.94
	EB	0.60	0.65
	LN SU	0.25	0.81
	SL COT	0.06	2.26
	CM MN	0	0
German G. - Spr.*	WCT	n/a	n/a
	EB	n/a	n/a
	LN SU	n/a	n/a
	SL COT	n/a	n/a
	CM MN	n/a	n/a
Above Hwy 1	RB	0.07	0.08
	WCT	0	0
	EB	0.13	0.33
	LN SU	0.13	0.08
	SL COT	0.52	1.80
	CM MN	0	0