MONTANA FISH, WILDLIFE AND PARKS
FISHERIES DIVISION

JOB PROGRESS REPORT

State:	**MONTANA**	**Element 1:**	**FISHERIES MANAGEMENT**
Project No:	**F-113-R-3, 4, 5**	**Job No:**	**3520, 3530**
Project Title:	**STATEWIDE FISHERIES INVESTIGATION**	**Job Title:**	**MID-YELLOWSTONE DRAINAGE INVESTIGATIONS**

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PROJECT PERIOD: JANUARY 1, 2003 THROUGH JANUARY 1, 2006

ABSTRACT

A population estimate performed during spring 2003 in the Big Timber Section of the Yellowstone River showed few notable changes in the fish population, with the exception of the near absence of Yellowstone cutthroat trout (YCT). Survey shocking in several locations from Otter Creek to Laurel to determine the effects of the prolonged drought on trout populations, indicated large numbers of 8-12 in rainbows present in the river. Low fall water conditions precluded performing a population estimate in the Laurel Section.

Electrofishing surveys performed in Esp Spring Creek yielded no cutthroat trout although other species of trout are using the creek for spawning. Juvenile rainbow and brown trout are present in the creek. A fish passage project was completed in 2004 to facilitate passage from the Yellowstone River into Esp Spring Creek during low water conditions.

Little Timber Creek, Big Timber Creek and Sweet Grass Creek, Crazy Mountain tributaries to the Yellowstone River, were surveyed in 2003 and 2004. Native fish, including many non-salmonid species, dominate the fisheries of lower Sweet Grass and Little Timber creeks. Brook and brown trout are abundant in upper Sweet Grass Creek near Melville. Brook trout are very abundant (2444/mi) in Big Timber Creek near the U.S. Forest Service (USFS) boundary. Rainbow and brown trout are also present, but at much lower densities than brook trout.

Lower Deer Creek, the West Fork of Lower Deer Creek and Placer Gulch were sampled. The initial McBride Lake Yellowstone cutthroat trout stocked there have survived well upstream of the barrier waterfall, and should begin to reproduce naturally in 2005. Electrofishing on three sections of Lower Deer Creek, downstream of the Forest Service boundary, occurred in 2005. Yellowstone cutthroat trout were present at relatively low densities compared to brown trout. Results of genetic samples collected from cutthroat trout that may have hybridized with escaped

rainbows from private ponds in the drainage, are pending. Fish, Wildlife & Parks (FWP), the Gallatin National Forest, and the Department of Natural Resources and Conservation (DNRC) signed a cooperative agreement to construct a barrier on Lower Deer Creek and isolate an additional 6 miles of habitat from non-native fish.

The farthest upstream culvert of upper Deer Creek was sampled. Brook trout at this location are abundant, and a remnant cutthroat population still exists. Genetic samples of cutthroat were collected for analysis.

A Yellowstone cutthroat restoration project to eliminate the brook trout population in Soda Butte Creek was initiated in the fall of 2004. A small headwater tributary was chemically treated with rotenone to remove brook trout, and the main creek was electrofished from its headwaters to Yellowstone National Park. These removal efforts continued in 2005. In those 2 years, slow but noticeable changes have occurred in the brook trout population.

In the summer of 2005, YCT were introduced into Miller and Sheep creeks (tributaries to Soda Butte Creek). The streams will be stocked again in 2006 and 2007, and stocking success monitored.

In the summer of 2005, Hidden Lake and the Buffalo Fork of Slough Creek were surveyed. The purpose of the survey was to determine the present status of the rainbow fishery in Montana and identify natural barriers to fish movement. Rainbow trout are hybridizing with cutthroat trout in Slough Creek. The most likely source of these rainbows is the Buffalo Fork where they are abundant throughout the reaches surveyed. Hidden Lake also has an abundant rainbow trout population. Two natural barrier waterfalls are present in the creek in Montana just within Yellowstone National Park.

Fish population in the B2 section of the Boulder River in 2004 was less (1591/mi) than the 2000 estimate (2143/mi). The major reason for the observed decline in fish numbers was fewer rainbow trout in 2005. Although reliability of the rainbow estimate is questionable due to large numbers of spawning fish migrating through the section, management goals for this reach of river were met, and the overall fish population in the B2 section appears in good shape.

In conjunction with the monitoring of a 1000-ft bank stabilization project, Beaver Meadows Ranch was surveyed for brown and rainbow trout spawning. Total redd counts that have steadily declined in the section, peaked in 2003. Redd counts in spawning areas immediately downstream of the project increased initially, and then steadily decreased after 2003. Upstream of the reconstructed bank, redd numbers stayed relatively constant.

Fourteen tributaries to the upper Boulder River upstream of the Natural Bridge were inventoried during the summer of 2003, with most streams electrofished near their confluence with the Boulder River. Exceptions to this were Great Falls Creek (fishless) and Meatrack Creek. Tributaries downstream of Four Mile Creek were dominated by rainbow and brook trout but densities were low. Four Mile Creek contained much greater densities of cutthroat, rainbow and hybrid fish. Meatrack Creek, a tributary to Four Mile Creek, contained a 99% pure population of cutthroat trout. Rainbows from Four Mile, however, are invading the population, while upstream the majority of trout captured were cutthroat or hybrid fish. A project is being initiated to protect the Meatrack population of cutthroat and convert the Four Mile Drainage to cutthroat.

In a cooperative effort between FWP, Montana Trout Unlimited, and the Stillwater Mine, 5 sites were surveyed in the East Boulder River. Trout populations at all sites increased from previous estimates. The cutthroat trout population in Placer Basin appears healthy and robust. Since 2001, of the three sites on the lower river, B6 remained relatively constant, while B4 and B5 experienced declines in overall trout abundance. Despite that, all age classes of fish from age-0 through 4+ were well represented.

Fish rescue operations continued in the Boulder River ditches. From 2003-2005, a total of 895 brown and rainbow trout were captured in the fall in Nelson Ditch and returned to the Boulder River. Other species in Nelson included Yellowstone cutthroat trout, mottles sculpin, mountain whitefish, white sucker and longnose dace. Dry Creek Canal was also electrofished during 2004 and 2005.

Population estimates for brown and rainbow trout were made in the Moraine and Absarokee Sections of the Stillwater River. From 2000 to 2003, the overall population size decreased from 3695/mi to 2822/mi at the Moraine site, with decreases for both rainbow and brown trout. Despite the slightly lower population, all age classes of fish were well represented with trout numbers still above the long-term average for the site. Conversely, the total trout population in the Absarokee Section increased from 2003 to 2005 (3371/mi to 4483/mi). Brown trout numbers remained relatively constant from 2003-2004, with slight shifts in the abundance of different age classes, while rainbows, particularly age-1 and age-2 fish, increased substantially. Total trout biomass for the site is the greatest it has been since sampling was initiated in 1992.

The MacKay section of West Rosebud Creek was sampled in the fall of 2004. The brown trout population estimate for the site more than doubled (959/mi to 2577/mi) since it was last sampled in 1998, though much of the total increase (1575) in 2004 was due to an inflated estimate of age-0 fish. Discounting age-0 fish, the estimate was comparable to that of 1998.

Relicensing of the Mystic Hydropower project on West Rosebud Creek required several studies to determine the present status of the fishery and the potential effects of power production on fish and their habitats. Three sections in the bypass reach of West Rosebud Creek between Mystic Dam and the powerhouse were electrofished. A population estimate in one of those reaches yielded a total rainbow trout estimate of 4848/mi. All age classes of fish were present in the stream at all three sites, including recently emerged age-0 fish, suggesting natural reproduction is occurring in the bypass reach of stream. Only rainbow trout inhabit the bypass reach, except near the powerhouse where one brown trout was captured. Fish were abundant at all locations electrofished, suggesting the current power production practices are having little affect on the fishery. A brown trout spawning count was also performed in West Rosebud Creek from the downstream end of the MacKay Ranch to Pine Grove Campground.

The rehabilitation of Bad Canyon Creek was completed. Brown trout were successfully removed from the upper 3 miles of the stream in 2002. In addition to the 21 cutthroats salvaged prior to chemical treatment, the stream was restocked with LeHardy Rapids YCT in 2003 and 2004. In 2005, fish survival was sampled at 8 locations in Bad Canyon Creek, starting at its confluence with the Stillwater River to upstream of Tepee Creek. Stocked fish have survived, grown and dispersed well in the creek, but have not yet colonized the reach upstream of Tepee

Creek. The overall cutthroat density is still roughly one-half to one-quarter the previous density of brown trout. The 21 salvaged cutthroat successfully spawned in 2003 and 2004. In 2006, the first plant of LeHardy Rapids cutthroat should reach sexual maturity and spawn in the creek. As stocked and wild fish spawn, cutthroat density should increase. Brown trout downstream of the barrier are beginning to recover; cutthroat stocked in this reach are also doing well.

Goose Creek was inventoried in 2003 and 2005. Brook trout dominate the fishery in the lower reaches of the creek, but a small 2-3 ft cascade keeps them from colonizing Goose Lake. A large 20-25 ft waterfall is present between the first and second meadows of Goose Creek downstream of Jeff Lake. A plan is being developed to restore cutthroat in Goose Creek and eliminate the brook trout population in the lower drainage.

A brown trout population estimate of 1266/mi was conducted at the Highway 419 bridge crossing of Fishtail Creek. Only 2 rainbow trout and 1 white sucker were captured.

Morse Creek, a tributary to East Rosebud Creek, was inventoried to determine the potential of restoring cutthroat there. Only longnose dace were found in the beaver pond-dominated upper reaches of the creek. In the lower reaches of the creek, downstream of the ranch buildings, brown and brook trout were present in addition to longnose dace and white suckers. Because of the abundant beaver dams, it was unclear whether the upper reaches of the creek contain any salmonids. Prolific beaver activity in the lower reaches of the creek would make cutthroat restoration difficult.

The total trout population in the Fox section of Rock Creek has increased steadily since 1994. The population estimate performed in 2005 showed an increase of 38% (1244/mi) since 2002, and is the greatest number recorded at the site (1994/mi). Both the rainbow and brown trout populations have increased; however, the rainbow trout population has more than tripled in the past 7 years.

A fish passage project on Clear Creek near the confluence of Rock Creek was completed in 2005. A box culvert perched 2.7 feet above the original bed of the creek made fish passage difficult for trout and impossible for other native fishes. The area was restored by constructing a series of step pools out of large boulders which raised the elevation of the stream bed even with the culvert.

Electrofishing surveys were conducted in Red Lodge Creek downstream of Cooney Reservoir, in West Red Lodge Creek near the Highway 78 crossing, and in Thiel and Harney creeks. Additional surveys were conducted in Willow Creek.

A Yellowstone cutthroat restoration project to suppress brook trout numbers and allow the cutthroat population to grow, was initiated in 2004 in the Brushy Fork of Willow Creek. Once the population increased, the cutthroat would be transported to a fishless stream. Complete elimination of brook trout would not be likely in Brushy Fork because of the abundance of beaver dams and complex land ownership in the area. During 2004 and 2005, 659 brook trout were removed from the creek. In 2005, 1 rainbow trout was also captured and removed. Genetic samples taken from fish in 2005, including age-0 fish, could have potentially been hybrids.

Whirling disease was detected in the Clarks Fork of the Yellowstone River from Bennett Creek in Wyoming to Bridger. The disease was not detected farther downstream than Bridger or in Bluewater Creek or Rock Creek. Infection rates in Wyoming and near the Montana-Wyoming line were severe. The disease was present in the Yellowstone River at Grey Bear Fishing Access, but not at Bratten, Columbus, Buffalo Mirage or Duck Creek. There was no indication of the disease in the Boulder River, but 1 fish near the mouth of the Stillwater River tested positive for the disease.

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS (Cont'd)

PAGE

LIST OF FIGURES

LIST OF FIGURES (Cont'd)

LIST OF TABLES

LIST OF TABLES (Cont'd)

PROCEDURES

Trout population densities were monitored in sections of the Yellowstone River, Stillwater River, Boulder River, East Boulder River and Rock Creek drainages. Inventory electrofishing is used on portions of the mid-Yellowstone River to gather qualitative information about fish populations. Trout population densities are usually estimated using mark-recapture methods described by Vincent (1971), or, in some cases on smaller streams, estimates are made using two-pass depletion (Leathe 1983), or three pass removals (FA+, FWP 2004). Mark-recapture population estimates are calculated using either the log-likelihood method (FA+) or modified Peterson method (described in Vincent, 1971). For most small stream electrofishing, a Smith-Root LR24 backpack electrofishing unit was used. Exceptions are noted in the results section. Age data was determined by taking scale samples from individual fish (up to 10 from each 0.5 in size group), then mounting and pressing these into plastic scale cards. Using a microfiche reader, annuli from the scale card impressions were then counted and fish ages recorded.

Stream temperatures were recorded in the Yellowstone River at three locations during the summer and fall of 2003-2005. Thermographs were installed in the river at areas of significant flow (generally along riprapped banks), cabled to the shore, and set to record water temperatures at 20 minute intervals using Onset WaterTemp Pro thermologgers.

Two-pass electrofishing estimates and water temperatures were recorded in Little Timber Creek during 2004 to assess the fishery and determine suitability for cutthroat trout restoration. Backpack electrofishing using the Smith-Root LR24, took place near the mouth, and approximately 2 miles upstream from the mouth, using the same thermologger and settings as in the Yellowstone River.

In 2004, Yellowstone cutthroat restoration projects aimed at removing non-native brook trout to protect the existing cutthroat population were initiated in Soda Butte Creek and the Brushy Fork of Willow Creek. The project in Soda Butte consisted of a short chemical treatment with rotenone in the headwaters, and electrofishing in the lower reaches of the creek. In the Brushy Fork of Willow Creek, brook trout were electrofished to suppress them and increase cutthroat abundance. A more detailed description of the methods used in these two projects is given in the Results and Discussion section.

In the spring and fall of 2003-2005, FWP evaluated the rainbow and brown trout spawning activity in the mid-Boulder River on the Beaver Meadows Ranch (BMR) near Natural Bridge. Surveys by FWP (Poore 2000) identified 20 areas with suitable spawning substrate gravels (0.5-1.5 in). These areas were given a number and letter code representing their location within or outside of the original treatment area (see Olsen 2003, Appendix A, Figures 1&2). The entire survey reach is approximately 3 miles long, beginning at the first bridge below the Natural Bridge Falls, and extending downstream close to the property boundary of the BMR. Biologists from FWP and Water Consulting Inc. surveyed the treatment and adjacent control reaches, counting rainbow and brown trout and their redds. Whenever possible, and to maximize in-water visibility, surveys were conducted on clear, sunny, wind-free days. Even so, weather conditions were variable between and within days. The surveys generally occurred between 10:00 AM and 4:00 PM to reduce both glare and shadows on the water's surface. Redd counts consisted of only

redds that were clearly defined, and are, therefore, conservative in number. Rainbow and brown trout counts represent only fish that could be clearly identified as either spawning or holding in areas adjacent to spawning activity. Redd and rainbow trout locations were marked on aerial photos.

In September 2003, 5 sites (Placer Basin, B-4, 5, 6, and Elk Creek) were sampled in the East Boulder River drainage, from the headwaters to below the mouth of Elk Creek. Two-pass electrofishing was used to estimate abundance at 4 sites and 3-pass removal was used at B5. Scale samples from the first 10 fish captured within each 0.5 in size grouping were collected at B4 and B5.

A fish rescue operation was performed on the Lamp-Nelson Ditch that originates approximately 5 miles upstream of Big Timber on the Boulder River. Water in the ditch was lowered prior to sampling, concentrating fish in deeper water (e.g., culverts, weirs and diversions). After capture, the fish were returned to the Boulder. A small portion of Dry Creek Canal, the largest ditch on the Boulder River, was also electrofished, but the canal had not yet been lowered, substantially reducing electrofishing efficiency.

Four sections of West Rosebud Creek from Mystic Dam to the powerhouse were surveyed to determine potential impacts of power production on the fish population. Three sites were electrofished and a mark-recapture completed in the fourth section. Because of low conductivity and higher flows, the battery powered Smith-Root LR 24 was ineffective at catching fish, so a gas powered, Colfelt electrofishing unit was used. The unit was set at 60 Hz, and 450 V. Length was measured at the three sites and fish were weighed on the recapture run. Additionally, a fall spawning count was performed on 5 miles of West Rosebud Creek downstream from Pine Grove Campground using the same methodology as Beaver Meadows.

Through a cooperative agreement and with funds provided by the USFS, fish surveys and a stream inventory were performed on the Custer National Forest (CNF) and adjacent private lands. Electrofishing was used to determine fish populations and species composition, and stream inventory to determine Yellowstone cutthroat populations in the CNF, and identify fishless waters that may be suitable for cutthroat introduction. Fin clips were taken from all cutthroat trout for genetic analysis.

In 2004 and 2005, fish were tested for whirling disease in many streams in Region 5. Testing consisted of incubating age-0 Irwin strain rainbow trout in live cages for 7-10 days in the suspected stream, during the fall or spring, when the disease spores are most prevalent. All sampling was done in the fall. After incubation in the stream, the fish were then transported back to the laboratory and held in tanks for an additional 3 months to allow the disease to develop before the fish were killed and tested for the pathogen. A minimum of 50 fish were generally tested for the disease at each site.

RESULTS AND DISCUSSION

Yellowstone River and Small Tributaries

Big Timber Section

The 7.1-mi Big Timber section of the Yellowstone River begins about one-half mile below the mouth of Little Timber Creek and extends downstream to one-half mile below the mouth of Otter Creek. All fish population estimates were done in the spring except for one fall estimate during 1992. This fall estimate is not directly comparable with the spring fish population numbers (Poore 1995).

The total trout population estimate for this section was lower during 2003 (582) than during the last survey in 1999 (925) (Figure 1). Estimates for all three species declined, with the most notable and troubling decline being that of Yellowstone cutthroat trout. In 1999, the population of YCT in the Big Timber Section was 216 fish per mile, but during 2003 only 6 YCT were captured in the entire section. Although the reason for YCT decline in this section is unknown, it may be related to the prolonged drought, lower water levels, and increased temperatures. Low water precluded sampling in this section of river prior to 2003, so it is difficult to conclude what factors led to the decline in cutthroat numbers.

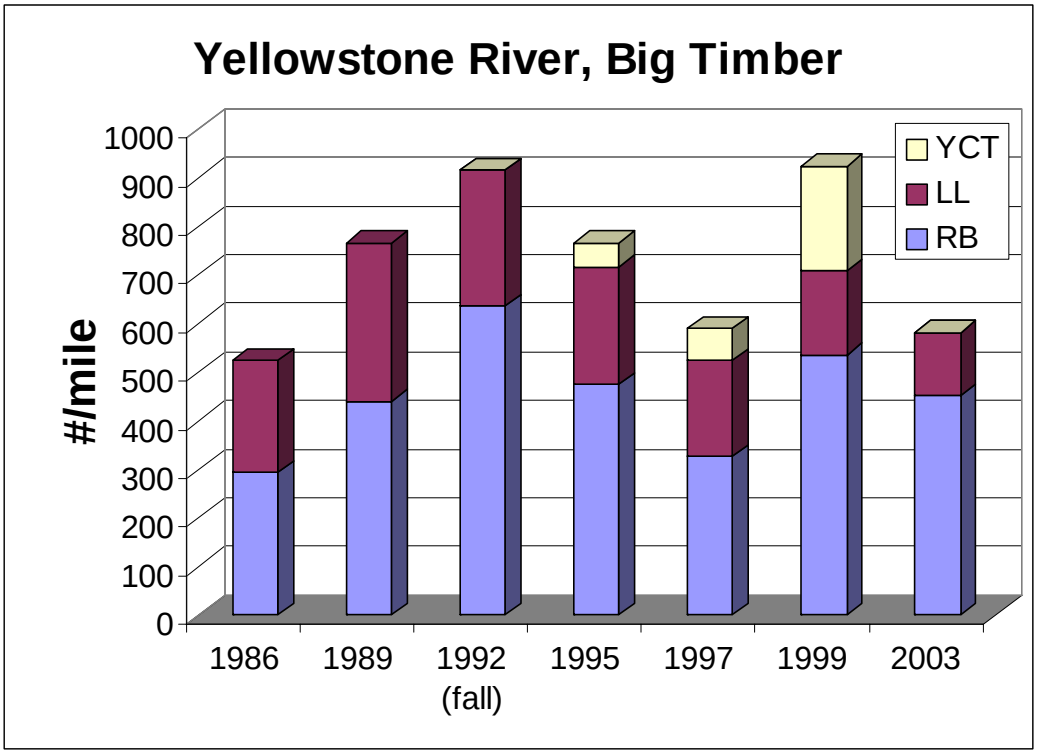

Figure 1. Population estimates for the Big Timber Section of the Yellowstone River.

Rainbow trout population estimate completed during the spring of 2003 was down 15% from 1999, to 452/mile, but near the longer-term average for the section (Figure 1). Despite

slightly lower numbers, the overall biomass of rainbows in the section is nearly equal to what it was in 1999 (Figure 2), suggesting that numbers of larger fish remained relatively constant. In fact, the largest decrease (180%) occurred in age-2 fish, which declined from 482/mi in 1999 to 172/mi in 2003. Estimates for other age classes differed less than 25% between sampling times.

In 2003, the brown trout estimate of 130/mi was 23% less than the 1999 estimate of 173/mi. Most of these reductions occurred in age-2 and 3 brown trout, with the average size captured being 16.0 in and 1.48 lb. The data collected for brown, rainbow, and cutthroat trout during 1999 were greater than previous estimates, likely due to preceding very good water years (Poore 2000). Very high water years with flooding in 1996 and 1997 led to a decrease in the overall population of trout. Following the floods, however, trout numbers increased substantially (Figure 1). The current ongoing drought reveals somewhat declining trout numbers. Because of the difficulty of sampling this section in low water conditions, the data should be viewed with discretion. Several side channels and banks of the river were inaccessible during electrofishing in March and had to be bypassed. Anecdotal information from anglers suggests that fishing has been very good in this reach of the Yellowstone, but it is unclear if good fishing is related to greater numbers of fish or if low water conditions make fish more vulnerable to angling.

Table 1. Trout population and biomass estimates from the Big Timber Section of the Yellowstone River, 2003.

Species	Age Class	Average Length (in)	Average Weight (lb)	#/mi*	Biomass (lb/mi)
Rainbow trout					
	1	5.4	0.06	17 (2)	1
	2	9.7	0.35	172 (14)	60
	3	12.5	0.75	131 (13)	98
	4	15.4	1.28	95 (10)	121
	5	17.2	1.76	29 (6)	52
	≥6	17.7	1.90	8 (3)	16
			Totals	**452 (23)**	**347**
Brown trout					
	1				
	2	10.0	0.39	31 (3)	12
	3	14.6	1.13	52 (4)	59
	4	17.9	1.86	38 (3)	70
	≥5	20.1	3.02	9 (2)	24
			Totals	**130 (6)**	**165**

* Numbers in parentheses represent the standard deviation of the estimate.

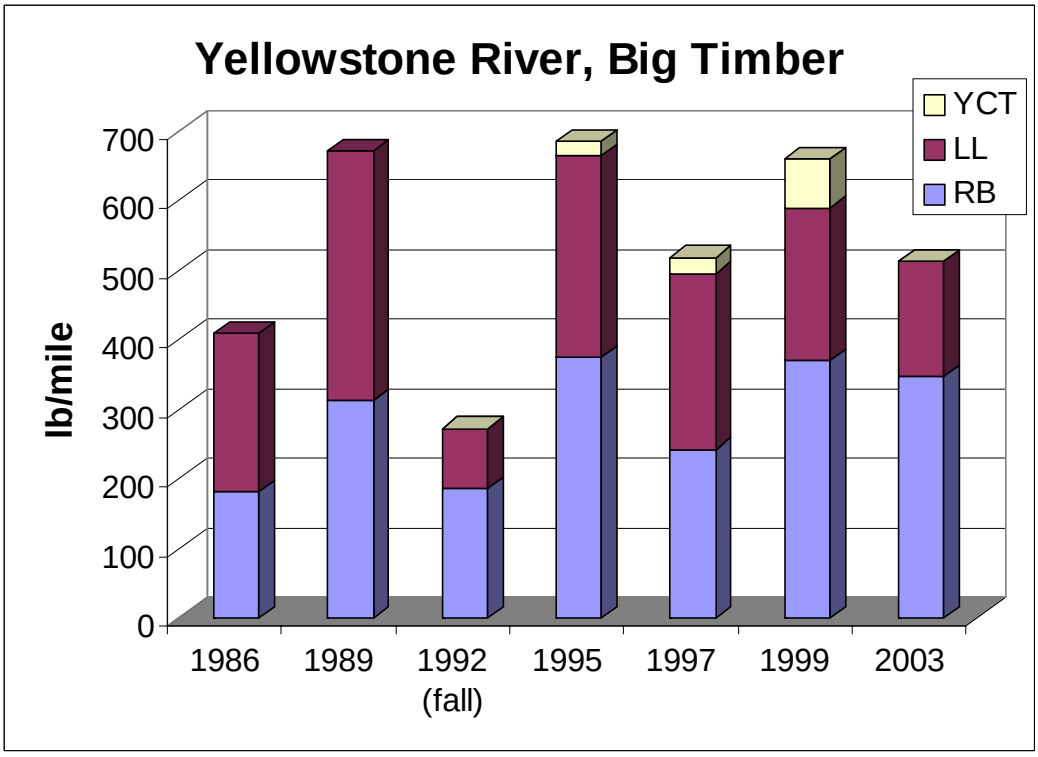

Figure 2. Biomass of trout in the Big Timber Section of the Yellowstone River.

Survey Shocking on Yellowstone River

During spring 2004, electrofishing was performed in several reaches of the Yellowstone River from Little Timber Creek to Laurel to obtain a general idea of the status of the fish population. The sections sampled, from the farthest upstream to the farthest downstream, were Little Timber Creek to Otter Creek (Big Timber Section); upstream 5 miles of Bratten Fishing Access Site (FAS) to Bratten; from Reed Point to Twin Bridges; and from Buffalo Mirage FAS to Laurel (Laurel Section). A total of 154 trout were captured in the Big Timber Section (106 rainbows and 28 browns). Rainbows ranged in size from 4.4-19.6 in (mean = 12.9 in) and 0.04-2.89 lb (mean = 0.97 lb). Brown trout ranged in size from 6.5-25.2 in (mean = 15.6 in), and 0.10-6.20 lb (mean = 1.66 lb). Similar data were collected the previous year from the section. Upstream of Bratten FAS, 72 rainbows and 45 brown trout were captured. Rainbows ranged in size from 5.6-19.5 in (mean = 11.4 in) and 0.17-2.20 lb (mean = 0.66 lb), and brown trout ranged in size from 7.2-22.4 in (mean = 15.5 in), and 0.13-3.84 lb (mean = 1.51 lb). No data were available to compare numbers of fish, but fish densities and size distribution appeared similar to those of the Big Timber section. From Reed Point to Twin Bridges, 88 rainbows and 35 brown trout were captured. Rainbows ranged in size from 3.0-17.5 in (mean = 11.5 in) and 0.02-2.28 lb (mean = 0.66 lb), and brown trout ranged in size from 3.0-19.6 in (mean = 12.0 in), and 0.02-2.18 lb (mean = 0.73 lb). Fish densities and size distribution also appeared similar to the Big Timber section. In the Laurel section, 165 rainbows, 60 brown trout, 8 Yellowstone cutthroat trout and 1 burbot were captured. Rainbow trout ranged in size from 7.1-18.9 in (mean = 11.0 in) and 0.15-2.28 lb (mean = 0.55 lb). Brown trout ranged in size from 8.7-18.0 in (mean = 11.8 in) and 0.20-2.09 lb (mean = 0.58 lb) and cutthroat trout ranged in size from 5.1-8.5 in (mean = 7.1 in) and 0.06-0.19 lb (mean = 0.12 lb). The cutthroat captured were fish stocked in the

Yellowstone River in the Billings area only a few weeks prior to electrofishing. The relatively small average size of rainbow trout from each of these sections was due to an abundance of 8-12 in fish. During electrofishing in 2004, 63 brown trout, 187 rainbow trout and 1 burbot were tagged with individually numbered Floy tags and released as part of a larger tagging study.

Yellowstone River Temperatures

During the summer of 2003, temperatures were at or near record levels during July and August. The warm temperatures, coupled with drought and low river levels, led to extremely high water temperatures in the Yellowstone River. Thermographs placed in the Yellowstone River near Big Timber, Columbus, and Sportsman's Park in Park City recorded temperatures in excess of 70ºF on a constant basis (Figure 3). To protect the long-term heath of fisheries that may be negatively affected by the combination of drought and angling, a drought closure policy was adopted by FWP in 2002. This policy states that when flows exceed the 95% monthly level of 1-in-20-year low flows; or reach, or exceed a daily maximum water temperature of 73ºF for some period of time during three consecutive days, certain closure options are warranted. River temperatures from Big Timber to Sportsman's Park frequently exceeded 73ºF. The maximum daily temperature recorded at each site was 76.6ºF at Sportsman's Park, 76.3ºF at Columbus and 74.5ºF at Big Timber. To protect the fishery, the Yellowstone River from Big Timber to the Huntley diversion dam was closed to angling during the warmest part of the day (noon to midnight) beginning August 1 and ending in early September. Despite the warm water temperatures in the Yellowstone, temperatures never exceeded 73ºF for 3 consecutive days in the Boulder or Stillwater rivers, or Rock Creek.

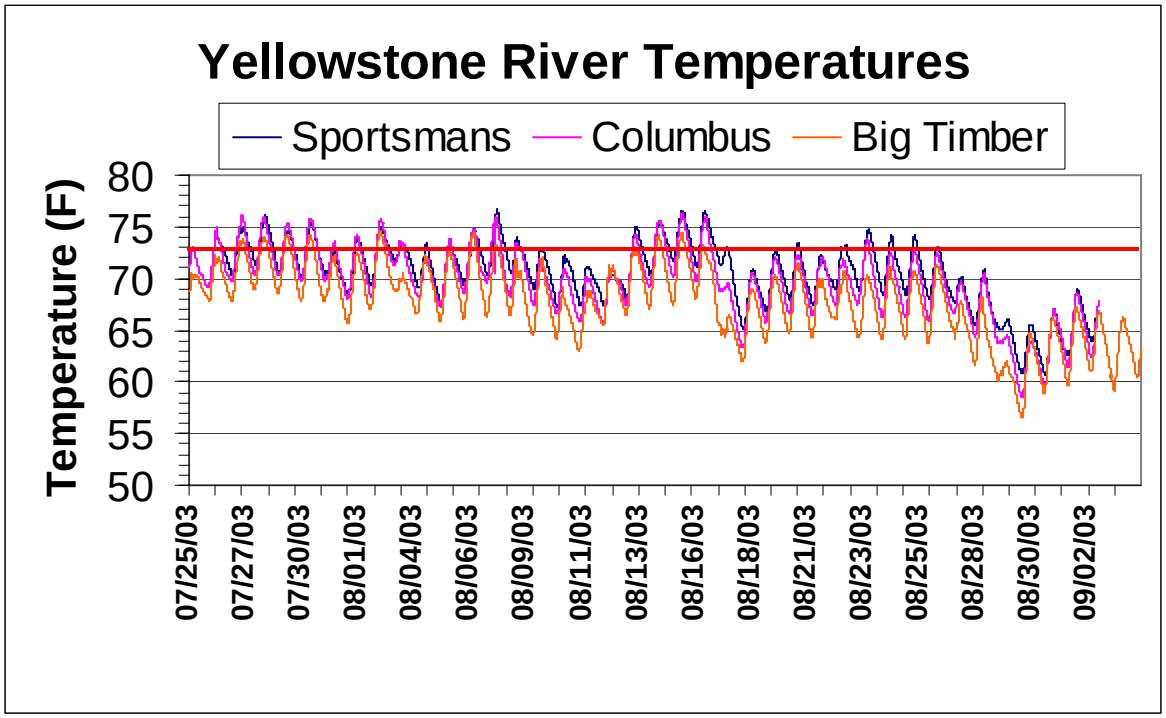

Figure 3. Water temperature from the Yellowstone River at three locations during summer 2003. Thick horizontal line (73ºF) represents the critical temperature at which drought restrictions can be implemented.

Little Timber Creek

Little Timber Creek, a tributary to the Yellowstone River that drains from the Crazy Mountains approximately 7 miles upstream from the town of Big Timber, is said to harbor a population of Yellowstone cutthroat trout in its headwaters, but this has not been verified in recent years. To establish if YCT are present in the lower reaches, and, if not, determine the potential for cutthroat restoration there, a fish population survey was performed and stream temperature was monitored. Little Timber Creek is small, flowing 2-5 cfs at low flow, but maintains flow to the mouth in most years. Irrigation water taken from the creek leaves the lowest 2 miles dewatered at times.

Two sections were electrofished on the lower creek on July 2, 2004—a 2-pass estimate at the lower site and a single pass at the upper site. The first section began approximately 100 yards upstream of the confluence of the Yellowstone River and extended upstream 810 ft (N4582317, W109.03272). White sucker, mountain sucker, longnose sucker, longnose dace and mottled sculpin were present in the creek. Brown trout were also present (Table 2). Suckers were dominant at the lower site. The upper site began at the farm bridge across the creek at N45.82852 W109.04449 and extended upstream 500 ft, with the fish species nearly identical to that sampled farther downstream. Two additional native species were captured, mountain whitefish and lake chub. Thermal data suggests the stream is relatively warm during the summer months and this could negatively affect trout populations (Figure 4). No cutthroat trout were present in the lower creek and the fisheries and thermal data collected during 2004 would suggest these sections of Little Timber Creek have marginal potential for YCT restoration. The mostly native fish community is similar to those found in warmer prairie fish communities. The presence of brown trout suggests the habitat conditions are marginally suitable for trout. Areas farther upstream may be better suited for YCT restoration.

Table 2. Species, population estimates and average size of fish at 2 sites on Little Timber Creek, 2004. Numbers in parentheses are size ranges in inches.

Fish Species	Lower Site		Upper Site	
	(#/mile)	Avg. Length (in)	(#/caught)	Avg. Length (in)
Brown trout	111	9.4 (5.1-17.0)	4	6.9 (4.9-9.6)
White sucker	294	6.7 (2.1-10.4)	8	5.5 (2.1-7.3)
Longnose sucker	128	5.2 (2.2-8.0)	7	6.3 (3.5-8.0)
Mountain sucker	9*	3.3 (2.1-5.5)	2	4.5 (4.4-4.6)
Longnose dace	6*	3.1 (2.7-3.8)	5	3.5 (3.0-4.3)
Mottled sculpin	6*	2.8 (2.3-3.2)	1	3.3
Lake chub	-	-	5	3.5 (3.0-4.3)
Whitefish	-	-	1	2.7

* Insufficient depletion led to inaccurate estimate so number captured is listed

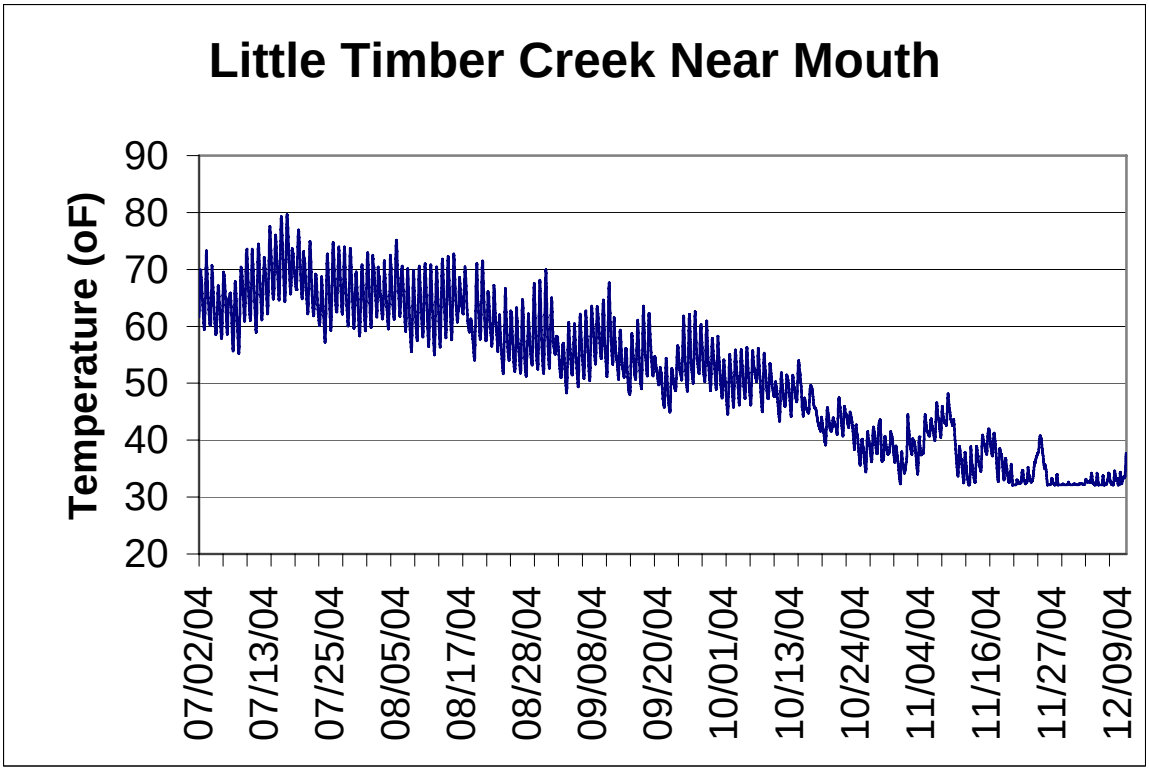

Figure 4. Summer and fall temperatures in Little Timber Creek, 2004.

Big Timber Creek

Big Timber Creek drains out of the Crazy Mountains south and east before entering the Yellowstone River at Big Timber. The creek is severely dewatered in the lower reaches and has several diversion dams that limit fish passage upstream. In September 1980, the creek was sampled at the Forest Service campground. A mark-recapture estimate was attempted, but high flows made electrofishing efficiency difficult and, therefore, no estimate was made. Twenty brook, 10 rainbow, and 5 brown trout were captured ranging in length from 4.9 to 11.1 in.

On March 29, 2005,the campground reach of Big Timber Creek was electrofished starting approximately 1,000 feet downstream of the campground and extending upstream 500 feet. Flows were very low, making electrofishing efficiency high. The same fish species present in 1980 were found in 2005, with brook trout being the dominant fish species (Table 3). During electrofishing, 222 brook, 39 rainbow, and 12 brown trout were captured. The combined population estimate for all species was over 4100 fish per mile. Fish size ranged from 2.1-11.9 in. No fish were weighed, but the overall condition of the brook trout was poor, while the condition of the browns and rainbows was average. The small-sized fish in this area may indicate substantial spawning in the stream. Another explanation could be cold water, due to its location at the mouth of Big Timber Canyon, and poor food conditions leading to slow growth. No scale samples were taken to determine the age of fish, so neither of these ideas could be confirmed.

Table 3. Trout population parameters from Big Timber Creek at the Forest Service Campground.

Fish species	# captured	#/mile	Avg. length	Length range
Brook trout	222	2444	5.2	2.3-9.1
Rainbow trout	39	1552	5.5	2.1-9.7
Brown trout	12	132	6.2	3.4-11.9
Total	273	4128		

Sweet Grass Creek

Ryan Sylvester, a graduate student from South Dakota State University, performed an extensive fisheries survey during 2003 on Sweet Grass Creek from its mouth near Grey Cliff, to the Gallatin National Forest in the Crazy Mountains. The aim of his study was to determine the species composition of the creek longitudinally. Eight sites on Sweet Grass Creek and one on Cayuse Creek were electrofished (Figure 5). Brown trout were distributed throughout the drainage at low densities (Table 4). Brook trout appeared limited to areas upstream of Melville. Native minnow and suckers dominated the fishery in the middle and lower reaches of the stream. Dewatering and warm water temperatures limit salmonids potential in lower Sweet Grass Creek. Further, irrigation diversion dams likely limit the use of the creek by migratory species of fish from the Yellowstone River. Actions to increase stream flows and facilitate fish passage in lower Sweet Grass Creek could have very substantial benefits to the fishery in the creek and in the Yellowstone River.

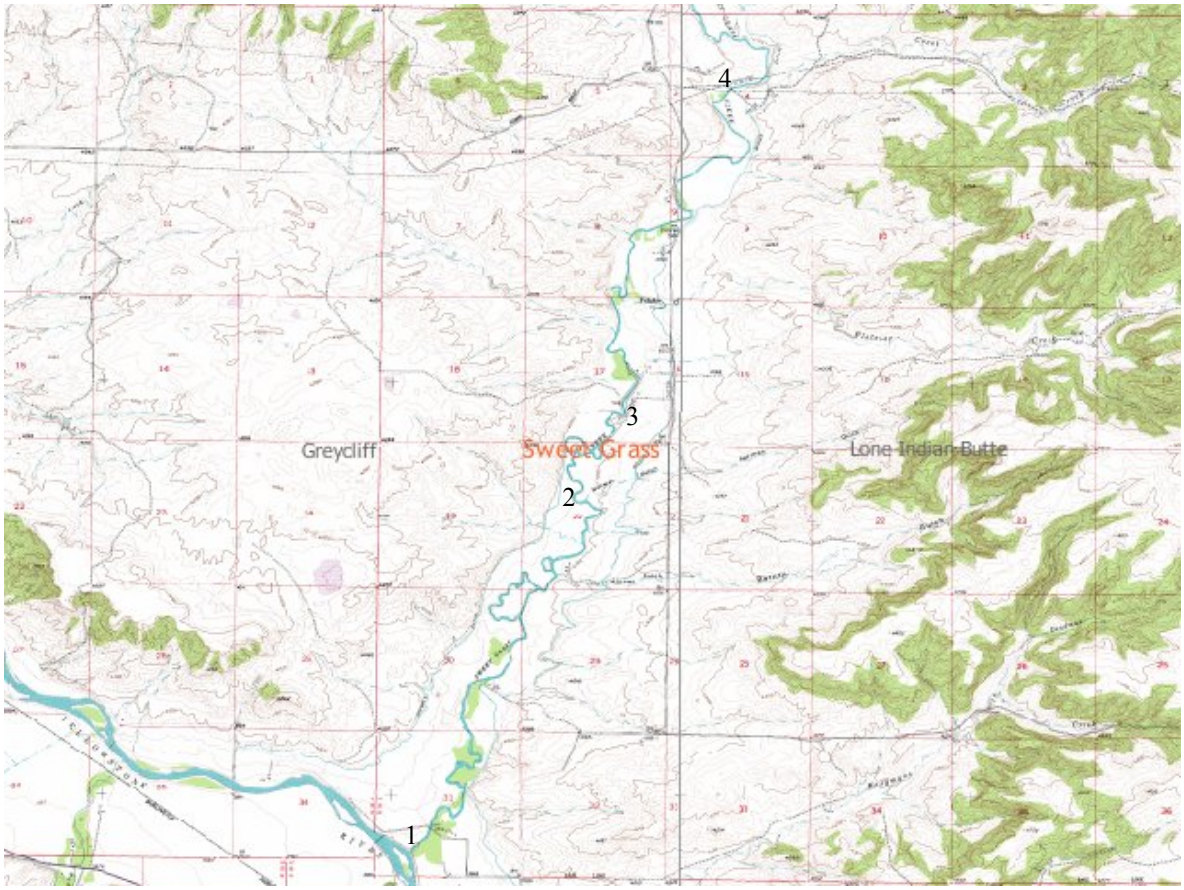

Figure 5. Map of lower Sweet Grass Creek showing the lower 4 sampling locations.

Table 4. Fish species collected from Sweet Grass Creek from its mouth to the Crazy Mountains and in Cayuse Creek, during 2003.

Fish Species	Numbers of fish at each sampling site								
	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*
Brown trout	1	2	1	1	3	13	3	6	0
Brook trout	0	0	0	0	0	3	48	34	0
Fathead minnow	3	9	2	1	0	0	0	0	0
Longnose dace	80	54	82	38	22	0	0	0	0
Lake chub	59	13	24	13	4	0	0	0	0
White sucker	18	18	20	18	17	0	0	0	1
Mountain sucker	23	10	40	19	11	0	0	0	0
Longnose sucker	0	0	0	0	3	0	0	0	0
Shorthead redhorse sucker	1	1	0	0	0	0	0	0	0
Brook stickleback	10	0	0	0	0	0	0	0	0
Mottled sculpin	11	0	0	0	0	0	0	0	0
Mountain whitefish	0	2	0	2	0	0	0	0	0
Stonecat	1	1	1	7	0	0	0	0	0
Location (UTM)	5070755 594126	5075065 595805	5075833 596430	5079903 597709	5082268 597460	5110067 571537	5112526 568249	5107832 577217	5111385 576687

* Site 9 was in Cayuse Creek, a tributary to Sweet Grass Creek

Esp Spring Creek

Esp Spring Creek is a tributary to the Yellowstone River about ten miles east of Big Timber, near the mouth of Upper Deer Creek. A spawning enhancement project was completed in 1999 (Poore 2000). From 1999-2001, remote stream incubators were used to incubate YCT eggs and establish a spawning population of cutthroats that would return to Esp Spring Creek, then migrate to the Yellowstone River as sub adults. Subsequent surveys found juvenile YCT, brown trout, rainbow trout, 2 brook stickleback, and mottled sculpin in the stream (Olsen 2003), indicating it was functioning well as rearing habitat for juvenile trout, and that the enhancement project had improved water quality and fish habitat. Spring spawning surveys in 2002 found no evidence of spawning by either rainbow or cutthroat trout. Cutthroat from the 1999 plant would have been 4 years old.

One of the potential limiting factors to the fishery in Esp Spring Creek is limited access at low water time periods. The confluence of the creek with the Yellowstone River is likely difficult for fish to negotiate because the creek spreads out and cascades down a steep bank. During high flows, however, the Yellowstone River partially backs up into the creek making access easier. Then, when YCT spawn in June, access to the creek is unrestricted, but more difficult for rainbow and brown trout during early spring and fall. A project performed at the mouth of the creek during July 2004, created a defined channel that directly accessed the Yellowstone River. It required hand moving rock and placing it to narrow the stream into a single channel. Two drop-pool structures were constructed to provide resting areas for fish as they negotiated their way into Esp Spring Creek.

During the spring of 2005, Esp Spring Creek was electrofished from the mouth of the creek to the railroad culvert to determine use by resident trout and any return of YCT to spawn in the creek. Brown and rainbow trout were present, as well as mottled sculpin and brook stickleback (Table 5), and the abundance of juvenile rainbow and brown trout in the stream suggested spawning. Electrofishing during the spring of 2001 found 30 juvenile YCT (3.1 to 4.7 in), 25 brown trout (3.3 to 7.1 in), 2 rainbow trout (2.7 to 7.1 in), 2 brook stickleback, and 3 mottled sculpin. Rainbow numbers have increased substantially in the creek, while browns have remained about the same. No cutthroat trout were found during 2005.

Table 5. Fish species and population parameters from fish collected in Esp Spring Creek. 95% CI is the 95% confidence interval of the population estimate.

Fish species	# caught	#/mile	95% CI	Avg. length (in)	Length range (in)
Rainbow trout	30	422	196-649	4.7	3.2-6.7
Brown trout	28	300	283-317	6.5	4.7-9.7
Mottled sculpin	9			4.4	3.6-5.2
Brook stickleback	2			3.1	2.9-3.3
Total	69	722			

Lower Deer Creek

Lower Deer Creek, from the forest boundary to approximately 6 miles upstream, contains a population of brown and pure Yellowstone cutthroat trout (Poore 1994). Several barrier

waterfalls 6 miles upstream of the boundary preclude fish from inhabiting that portion of the watershed. The stream from the USFS boundary downstream to its confluence with the Yellowstone River, also contains YCT, brown trout, and a few rainbows, but less is known about the fishery in this reach (Fredenberg et al. 1986). Lower Deer Creek is generally dry at the mouth because of irrigation diversions and natural subterranean flows. While YCT were stocked into Lower Deer Creek from 1935 to 1950 below the USFS boundary, it is possible that the cutthroats currently in Lower Deer Creek are a remnant of wild fish that originally had better access to the Yellowstone River. The earliest sampling date in the middle reaches of Lower Deer Creek occurred in 1987 when "a good population of Yellowstone cutthroat trout was found coexisting with brown trout" (Poore 1990). In 1990, 44 brown trout and 33 cutthroat trout were captured in the Gallatin National Forest (Poore 1994). In 2002, electrofishing at the Forest Service cabin, approximately 1 mile upstream from the confluence of Placer Gulch, found a healthy population of brown trout (802/mi) and Yellowstone cutthroat (399/mi).

An effort to secure the existing population of cutthroat trout, from the falls downstream to the Forest Service (FS) boundary, was made in 2004. An aerial survey identified the site with the most potential for barrier construction 1.1 miles downstream from the FS boundary on land owned and managed by the Department of Natural Resources and Conservation (DNRC) (T2S R15E Sec16). At this location, bedrock walls are present on both sides of the creek and the road is accessible from above the barrier, so equipment could easily access the site from downstream. A cooperative agreement was drafted between FWP, the Gallatin National Forest and DNRC to construct the barrier and protect the existing cutthroat population upstream. A design for the barrier is being prepared and work is being done with adjacent landowners to gain their cooperation for the project.

Lower Deer Creek, upstream and downstream of the potential barrier site, was electrofished to determine the fish composition and genetic status of YCT. Several ponds on private land are present in the Lower Deer Creek Drainage, and one is currently licensed for rainbow trout. It is unclear if fish have escaped and hybridized with cutthroat in Lower Deer Creek. Three sections were electrofished, beginning at the Four Creeks Ranch and downstream of the DNRC land mentioned (N45.67488, W109.88210). A 2-pass estimate over a 750-foot reach of stream adjacent to several ponds located within the floodplain of the creek, found no fish in the ponds and brown trout dominant in the creek (Table 6). All but one cutthroat captured were sub-adult fish, likely 1- and 2- year-olds. At the state section, brown trout were again the dominant trout species. Numbers of brown trout were nearly double, while cutthroat numbers were half those found at the Four Creeks Ranch (Table 6). No adult cutthroats were captured in the state section. A three-pass estimate in 500 feet of creek, upstream approximately one-fourth mile from the potential barrier site (Holman Section), captured only one cutthroat. The brown trout were abundant. It is evident from the data collected during 2005, that while cutthroat trout are present in the lower portions of the creek, their densities are low. It is unclear why there was an apparent lack of adult cutthroat in the lower reaches of the stream, but given the early spring sampling time during 2005, it is possible they were still in deeper wintering areas of the creek.

Table 6. Fish species and population parameters from fish collected in Lower Deer Creek. 95% CI is the 95% confidence interval of the population estimate.

Fish species	# caught	#/mile	95% CI	Avg. length (in)	Length range (in)
4 Creeks Section					
Brown trout	99	787	681-893	5.9	3.0-16.5
Yellowstone cutthroat	21	176	106-246	3.2	2.5-8.5
State Section					
Brown trout	178	1211	1014-1408	4.6	3.2-13.8
Yellowstone cutthroat	16	99	67-132	3.9	2.9-5.9
Sculpin	6			3.8	3.3-4.3
Holman Section					
Brown trout	106	1331	1109-1552	5.2	2.3-14.9
Yellowstone cutthroat	1	-	-	2.3	-

In an effort to expand their range, YCT were reintroduced into approximately 6 miles of Lower Deer Creek above a natural barrier falls during the summer of 2002. In 1992, the capture of 65 cutthroats from Lower Deer Creek for transport above the falls was not successful (Olsen 2003). In 2002 and 2003, three age classes of McBride Lake YCT were stocked upstream of the waterfall. During 2005, the first age class of fish stocked as 1-year-olds in 2002 should have spawned as 4-year-olds. On June 26, 2005, we surveyed Lower Deer Creek upstream of the falls. Spawning could not be determined due to electrofisher malfunction, but visual surveys indicated adult cutthroat (10-12 in) were common in pools. No active spawning or redds were noted.

West Fork Lower Deer Creek. This portion of Lower Deer Creek was surveyed for the presence of fish and the potential to support a cutthroat population in fishless areas. The stream was visually inventoried and spot electrofished from its headwaters to the confluence with Lower Deer Creek on June 21, 2005. Potential natural barriers were noted, photographed, and a GPS reading was taken. Although water flows and habitat were adequate, no fish were found in the upper reaches of the creek. Two potential natural barriers, cascades over bedrock, were located in the middle of the drainage (N45.56811 W109.92379 and N45.57048 W109.92509), but lacked sufficient relief as definite barriers. No fish were present immediately upstream or downstream of these sites. Electrofishing to within 0.5 miles of the confluence with Lower Deer Creek yielded no fish. Electrofishing from the mouth of the West Fork of Deer Creek 200 feet yielded 15 cutthroat trout ranging in size from 3.6-7.5 in. Previous surveys found no fish. The data suggests cutthroat trout use areas near the mouth of the creek, but not farther upstream, probably due to barriers. When compared to Placer Gulch, a similar-sized tributary to Lower Deer Creek with a self-sustaining cutthroat population, the West Fork of Lower Deer Creek has far superior habitat conditions and water quantity. It may, therefore, be a suitable location for the introduction of cutthroat trout. The limiting factor for cutthroat survival will likely be water quantity.

Upper Deer Creek

Upper Deer Creek contains a pure population of YCT near its headwaters (Poore 1990); brown and brook trout are also present. On September 23, 2004, a 590-foot section of Upper Deer Creek was sampled near its headwaters, immediately downstream of the Forest Service

road culvert (N45.34407 W109.58642). Brook trout were the dominant species in the creek (Table 7), and, although the sampling occurred in late September, recently emerged cutthroat trout fry were captured in the stream, indicating cold water temperatures. To determine the extent of the brook and cutthroat trout upstream, electrofishing took place upstream of the culvert 1.5 miles into the forks of the creek, where a series of potential barrier cascades was identified (N45.34120 W109.58830). Upstream of this location, no fish were captured. Although a greater proportion of cutthroat trout was found upstream of the culvert than was found downstream, no population estimate was attempted (Table 7). Fin clips were collected from cutthroat trout, however, for genetic analysis.

Table 7. Fish species and population parameters from fish collected in Upper Deer Creek. 95% CI is the 95% confidence interval of the population estimate.

Fish species	# caught	#/mile	95% CI	Avg. length (in)	Length range (in)
Below Culvert					
Brook trout	70	1890	1829-1951	4.4	2.0-9.5
Yellowstone cutthroat	7	63	-	6.0	0.4-10.8
Above Culvert					
Brook trout	40	-	-	5.3	2.3-8.6
Yellowstone cutthroat	19	-	-	6.6	3.8-10.8

Soda Butte Creek

Soda Butte Creek is a tributary to the Lamar River that originates 2 miles east of Cooke City (Figure 6). The main stream then flows through the McClaren Mine tailings prior to flowing past Cooke City. YCT are found in Soda Butte Creek, along with brook trout, that were likely introduced some time prior to 1974. Neither FWP nor the Wyoming Game and Fish Department have any record of stocking brook trout in Soda Butte Creek. Twenty-five cutthroat trout were collected from Soda Butte near Silvergate in 1989 to determine their genetic purity. Of the 25 fish analyzed, 20 were pure YCT, 4 were first generation westslope cutthroat hybrids, and 1 was a pure westslope cutthroat trout of unknown origin. A study to determine the distribution of cutthroat and brook trout in Soda Butte Creek was initiated in 1994 by the USFS, FWP, Wyoming Fish and Game and Yellowstone National Park (Shuler 1995, Poore 1997). Study Results indicated tributaries to upper Soda Butte Creek before it enters Yellowstone Park were primarily fishless, except near the confluence with the creek's mainstem. The mainstem Soda Butte Creek, therefore, appeared to be the source of brook trout in the system. Until recently, brook trout numbers were very low and were confined primarily to areas upstream of the McClaren Tailings. The acid mine drainage and associated poor water quality from the tailings pile apparently limited the dispersion of brook trout to areas farther downstream from Cooke City.

Initial electrofishing attempts were made in the 1990's to remove brook trout from upper Soda Butte Creek (Poore 2000), beginning with the area from the confluence of Woody Creek upstream to Highway 212. Subsequent samplings, however, found that brook trout persisted in the stream despite this effort. The numbers and sizes of fish captured after removal efforts indicated natural reproduction farther upstream from the initial removal area. A search for this source revealed a small unnamed tributary that flows under Highway 212, entering the main stream from the north near its origin (Figure 7), that contained an abundant population of brook trout and served as the source of downstream migrants each year. Brook trout were likely

introduced into the creek upstream of Highway 212 rather than at the highway culvert. There were no YCT upstream of the Highway 212 culvert.

A second attempt was made to mechanically remove brook trout from the confluence of Woody Creek to the headwaters of the unnamed tributary beyond the Highway 212 culvert. Electrofishing to remove brook trout in Soda Butte Creek from Woody Creek to Highway 212 was successful. Removal efforts, however, proved very difficult in the unnamed tributary. The fires of 1988 burned across most of this watershed, and the stream was cluttered with downed trees and logjams, making mechanical removal impossible. A plan was developed and an EA prepared for the chemical and mechanical removal of brook trout from Soda Butte Creek. The unnamed tributary would be chemically treated to remove brook trout, and Soda Butte Creek electrofished from the Highway 212 crossing east of Cooke City into Yellowstone National Park.

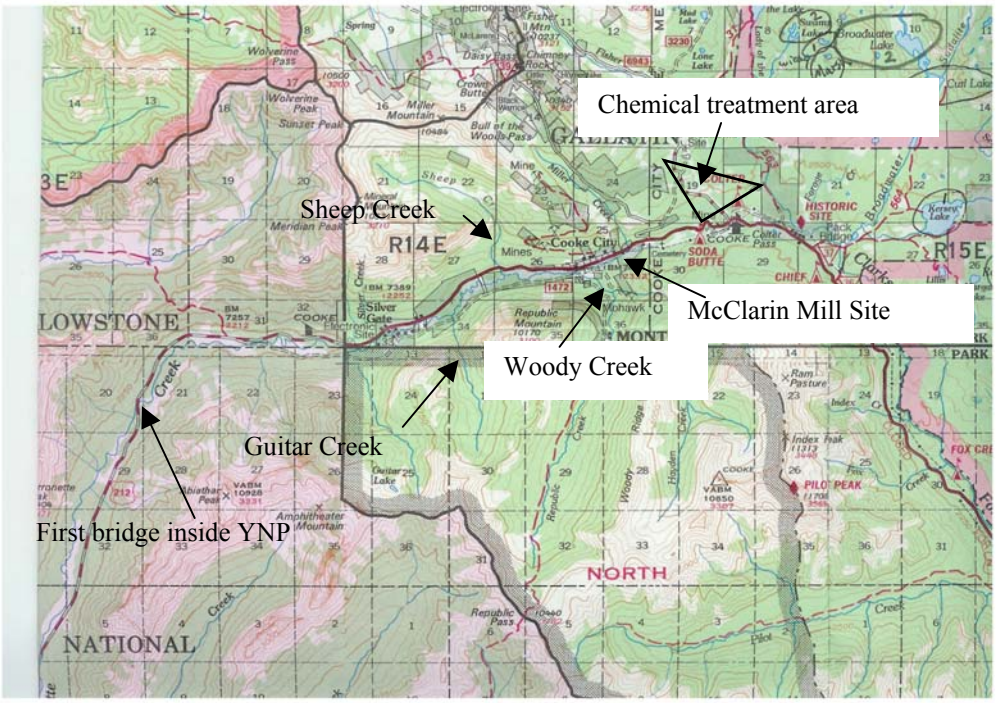

Figure 6. Soda Butte Creek Yellowstone cutthroat restoration area.

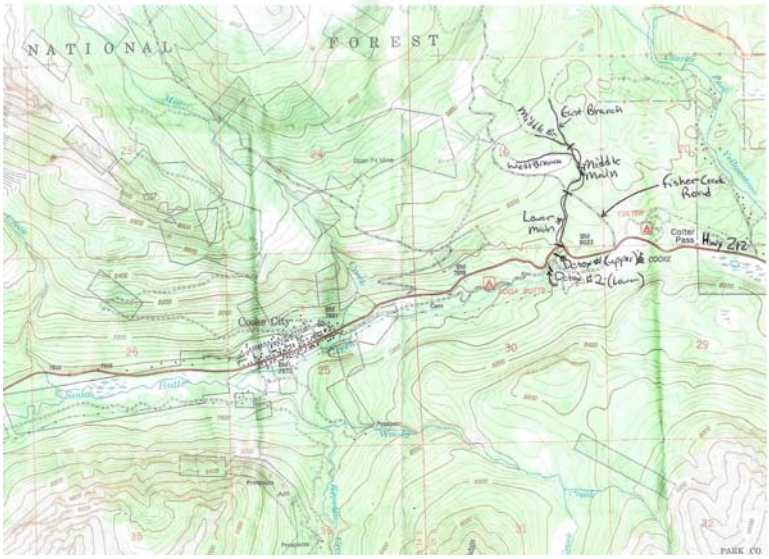

Figure 7. Map of the areas in upper Soda Butte Creek treated with piscicides.

Chemical Removal

Chemical removal of brook trout occurred in September 2004, after tests determined the appropriate chemical and concentration needed. The preferred piscicide for this project was antimycin (Olsen 2004), a fungicide that is extremely toxic to fish at very low concentrations. Testing with antimycin in the unnamed tributary indicated it was not effective at the maximum application rate of 10 parts per billion (ppb), so, our alternative chemical, rotenone, was tested. Rotenone was effective at a concentration of 1 part per million (ppm). Potassium permanganate ($KMnO_4$) was used to detoxify the rotenone and prevent the treated waters from going beyond the treatment area. That area was upstream of the Highway 212 culvert, and was divided into three sections: Lower Main, from the 212 culvert upstream to the Fisher Creek Road culvert; Middle Main, from the 212 culvert upstream to the confluence with the west branch of the

stream; and the three branches of the stream (Figure 7). Rotenone was applied to the Lower, Middle and East and West branches of the creek using constant-head drip stations, and the Middle Branch with a backpack sprayer because of low, and often intermittent, flows. Application spacing along the stream was determined during initial testing of the chemical. For the East and West branches, drip stations were located at 80 min intervals and in the main creek, stations were spaced at 120 min intervals. Rotenone was applied starting September 6, 2004. To avoid compounding the concentration of rotenone in the water, all sections were not treated simultaneously. The entire length of stream (approximately 1 mile) was treated twice during the week of September 6th.

Two detoxification stations were set up 50 yards (upper) and 200 yards (lower) downstream from Highway 212 (Figure 7) to ensure that rotenone-treated waters did not escape the project area. The upper detox was the primary area, and the lower served as a back-up in case the primary station did not effectively neutralize the rotenone. $KMnO_4$ was applied to the stream using a constant-head drip station with larger storage containers than those used to apply the rotenone. The lower detox was downstream of several springs, which tripled the flow of the creek. YCT from the Bluewater Springs Fish Hatchery were placed in cages and used as sentinel fish to monitor the effectiveness of detox in the stream. Fish were placed immediately upstream from the detoxification station and at a distance of 30 min (approximately 200 yards) downstream of the detoxification station. Fish response upstream from the detoxification station indicated when rotenone was present in the water, and fish response downstream indicated the effectiveness of the $KMnO_4$. Detoxification began on September 6th at the upper detox. No sentinel fish placed at 30 min downstream of the upper and lower detox stations died during the project, indicating successful detoxification of the rotenone. Fish upstream of the detox stations were killed, indicating successful removal of brook trout from the stream. Sentinel fish downstream from the lower detox were incubated in the stream for an additional 3 weeks after treatment, and no mortality occurred. After chemical removal was complete, dead brook trout were collected from the stream and transported to the Cooke City Solid Waste Disposal Site. More than 950 brook trout were removed from the unnamed tributary upstream from the Highway 212 culvert.

In July 2005, subsequent electrofishing in the unnamed tributary found one brook trout in the treated reach of the creek. The entire length of the unnamed tributary was electrofished a second time in August of 2005, and no brook trout were present. The creek will be electrofished one more time during 2006 to determine if brook trout are present in the stream, and if the chemical removal portion of the project was successful.

Pre- and post-project monitoring of the chemical treatment area. In a prepared EA, FWP committed to monitoring of the Soda Butte Creek Campground well adjacent to Soda Butte Creek and downstream of the treatment area, both before and after treatment. Before rotenone application, four water samples were collected and sent to the Montana Department of Public Health and Human Services, Environmental Laboratory in Helena for analysis. No rotenone was detected in the samples and no rotenone was found in the well water when it was retested prior to the opening of the campground in the spring of 2005.

An amphibian survey was conducted in and around the stream prior to treatment with rotenone. Adult spotted frogs were present in the treatment area and surrounding wetlands. No juvenile amphibians were found when the survey was conducted on August 24, but the habitat appeared suitable for reproduction. It appeared several adult-size frogs were born and metamorphosed in 2004. A total of three frogs were captured and identified, and two other frogs

were seen but not captured. Most frogs were not present in the stream, but were located in adjacent wetlands and spring areas. Rotenone does not affect adult amphibians that breathe air, only the juvenile amphibians that respire exclusively through their skin and/or gills. Subsequent amphibian surveys conducted during 2005 found adult spotted frogs were still present in the chemically treated area. A total of 5 frogs were observed, none were captured.

Rotenone has temporary negative affects on aquatic macroinvertebrates, reducing their numbers and causing species loss from streams. Invertebrate populations are very resilient, and populations generally fully recover within 1 or 2 years after treatment. To monitor the effects of the treatment in the unnamed tributary, macroinvertebrates were collected from two sites before treatment, 1 month after treatment, and 1 year after treatment, using the rapid bio-assessment protocol (DEQ 2004). On September 6, 2004, samples were collected upstream of the 212 culvert in the unnamed tributary (treatment area) and downstream of the detoxification area adjacent to the Soda Butte Creek Campground (control site) in the main Soda Butte Creek. The collector disturbed diagonal transects across the stream and dislodged invertebrates, which were captured in a kick net. Transect length and sample time were recorded. One sample was collected at each site before and after the treatment. Because the stream is small upstream of the 212 culvert (0.26 cfs), no diagonal transects were possible, and all habitat in the riffle areas was sampled. Post-treatment samples were collected on September 29, 2004, 19 days after any chemical was placed in the stream, allowing sufficient time for invertebrates killed by rotenone to decompose. Samples were preserved in 95% ethanol and analyzed by an independent contractor from Helena. Invertebrates were identified to species level when possible.

Minimal changes in the invertebrate composition at the control site (Figure 8) were likely due to low sample size (1 from each site). As expected, the abundance of invertebrates showed a dramatic decline in the treatment area immediately after treatment (Figure 9). Invertebrate numbers, however, rebounded 1 year after treatment to greater numbers, from 26 different species to 36. Of the 21 species present before treatment, 17 were present 1 year later. An additional 14 species were present 1 year after treatment that were not collected before, indicating a quick recovery of the macroinvertebrate population in the unnamed tributary to Soda Butte Creek.

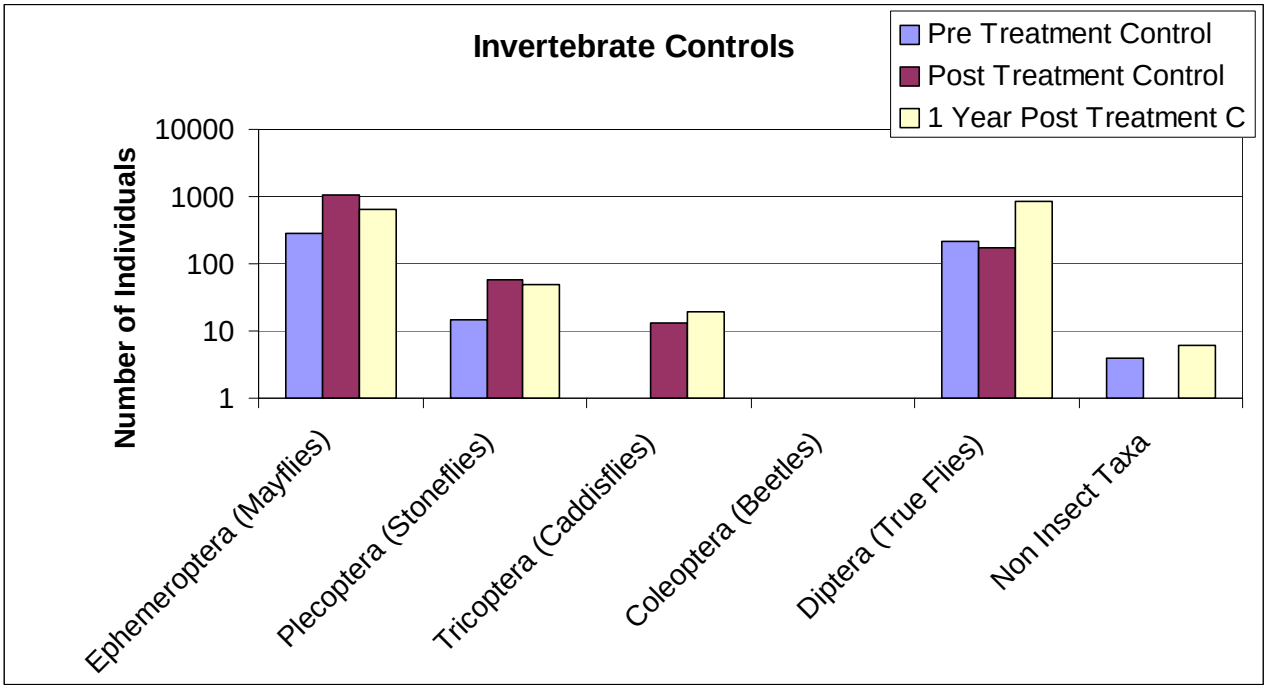

Figure 8. Number of aquatic macroinvertebrates collected from the Control Site in Soda Butte Creek.

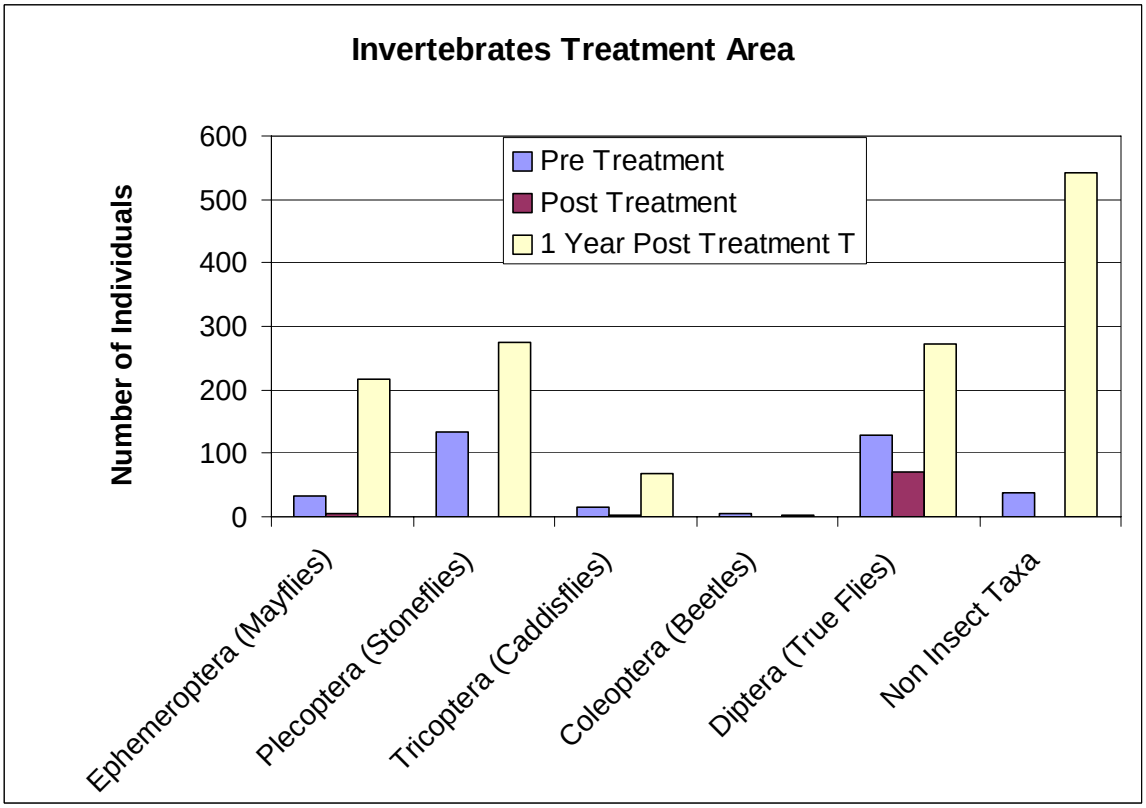

Figure 9. Number of aquatic macroinvertebrates collected from the chemical Treatment Site in the unnamed tributary to Soda Butte Creek.

Mechanical Removal. Mechanical removal efforts began on September 7, 2004, and were conducted simultaneously with the chemical removal. Soda Butte Creek was electrofished from the Highway 212 culvert, downstream to the Yellowstone National Park (YNP) boundary in 2004, and 3.5 miles into YNP in 2005. Backpack electrofishers were used in Soda Butte Creek upstream from the confluence of Woody Creek and in the tributary stream, and mobile anode "crawdad" shocking was used downstream of Woody Creek. The stream in this section was divided into 5 sections: the confluence of Woody Creek upstream to 212, Woody Creek to Sheep Creek, Sheep Creek to Guitar Creek, Guitar Creek to the YNP border, and the tributary streams. Two passes were performed in each section by two electrofishing crews. YCT were released back into the stream, and brook trout were killed. Mechanical removals occurred the week of September 7, 2004, and August 29, 2005 prior to brook trout spawning. In early October 2005, a second removal effort was conducted in the Sheep to Guitar section of the creek, after the brook trout spawn.

Electrofishing in the upper reaches of the creek from the end of the chemical treatment section at Highway 212 to Woody Creek at Cooke City revealed equal densities of brook trout to YCT during 2004 (Table 8). Only 2 fish smaller than 4 in were captured, suggesting that very little natural reproduction is occurring in this reach. Data from 2005 suggested that removal efforts were successful at removing larger spawning-sized fish (only one fish > 7 in was captured in 2005 and 17 fish > 7 in captured in 2004). Decreases in the numbers of juvenile fish, however, have not yet been observed. Additionally, 3 age-0 fish were captured during 2005, suggesting reproduction is still occurring in this reach. Numbers of YCT have increased with the reduction in brook trout. Over 100 YCT were captured upstream of Woody Creek as opposed to 28 the previous year. Of these fish, there were 6 age-1 fish that were not present the year before. The total number of cutthroat captured is somewhat misleading because 43 of the fish were escapees from our live cars the previous year. These fish were readily distinguishable from wild YCT because all hatchery fish were adipose fin-clipped. Despite the influence of hatchery fish, numbers of wild fish doubled from 2004 to 2005 upstream of Woody Creek.

Table 8. Numbers of fish captured during 2-pass and single pass electrofishing removals in Soda Butte Creek. Numbers in parenthesis are population estimates (#/mile) for the given section.

Section	Yellowstone cutthroat			Brook Trout		
	2004	2005a	2005b	2004	2005a	2005b
Hwy 212 to Woody Cr	28	129 (220)		34 (36)	20 (26)	
Woody Cr to Sheep Cr	393 (417)	572 (611)		8	43 (48)	
Sheep Cr to Guitar Cr	1378 (971)	1271 (1188)	1076 (1191)	251 (171)	401 (314)	145 (168)
Guitar Cr to Silver Gate	258	920 (1342)	1020 (1420)	9	291 (361)	92 (123)
Sil. G. to 1st bridge in YNP		1214			93	
Tributaries:						
Woody Creek	76 (261)			0		
Sheep Creek	10			0		
S. Moose Meadow Spring		7	3		16	13
N. Moose Meadow Spring		10			1	
Warm Springs Cr		16			0	

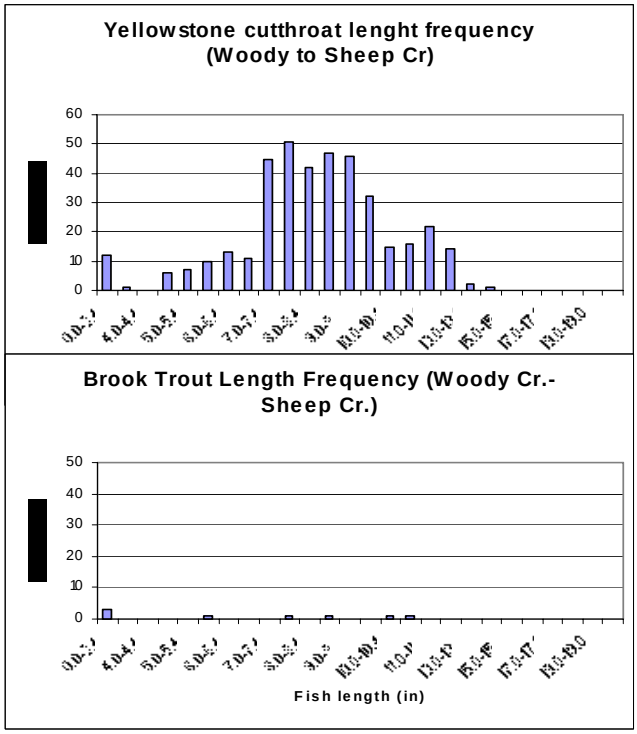

Figure 10. Length frequency fish from Soda Butte Creek, 2004.

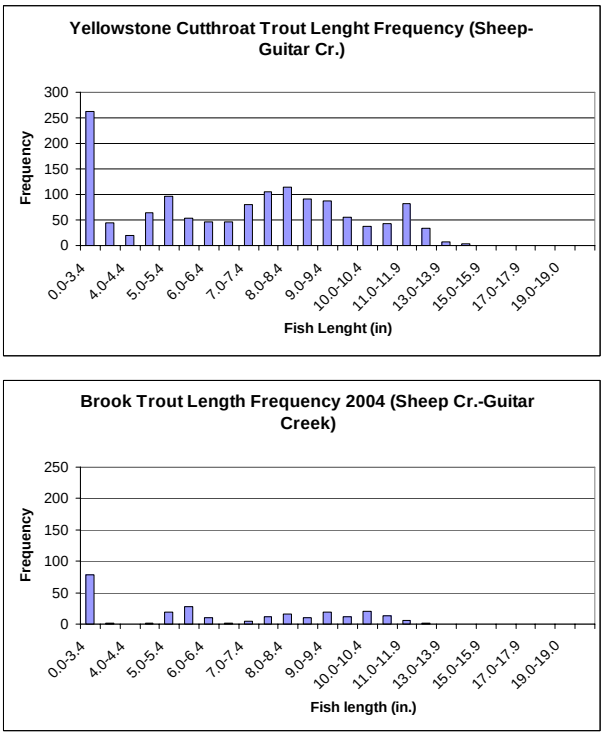

Figure 11. Length frequency of fish from Soda Butte Creek, 2004.

Few brook trout were removed during 2004 and 2005 from Woody to Sheep Creek (Table 8). The Yellowstone cutthroat population in this reach of stream appears to be healthy. Numbers of age-1 fish smaller than 3.5 in and length-frequency charts suggest some limited cutthroat reproduction is occurring (Figure 10).

From Sheep to Guitar Creek the numbers of both species change dramatically. The number of YCT doubled, and the number of brook trout increased ten fold or more (Table 8). Numbers of fish smaller than 3.5 in collected during 2004 was greater than any other size, suggesting this reach of stream is the primary spawning area for both species (Figure 11). During 2004, 251 brook trout were removed from this reach. In late August 2005, 401 brook trout were removed, a two-fold increase from the previous year. The reason for the increase in brook trout from 2004 to 2005 was a very strong year-class of age-0 fish (< 3.5 in) in 2004 that recruited to age 1 (>4 in, <7in) in 2005 (Figure 12). At age 1, the fish were larger and more susceptible to capture using electrofishing. Despite low capture efficiency of age-0 fish in 2004, removal efforts were more successful with larger sub-adult and adult fish (Figure 12). Because of the abundant brook trout and the concentrated spawning from Sheep to Guitar creek, efforts were doubled in this reach and immediately downstream from Guitar Creek to Silver Gate during 2005. Beginning on October 5, 2005, a second 2-pass removal was performed in these 2 reaches of stream. Length and weight measurements were not taken, but fish were classified as > 4 in and < 4 in to distinguish age-0 from older fish. During this second removal effort, 145 brook trout were captured and killed from Sheep to Guitar creek, a reduction of 64% from the previous month. Of these, only 19 were age 0. In order for mechanical removal efforts to be successful, spawning has to be eliminated. Although complete elimination of spawning adults has not occurred in Soda Butte Creek, adult numbers have been substantially reduced.

The YCT population from Sheep to Guitar creek was also greater than any other reach of stream sampled. The data suggested that this reach is an important spawning and rearing area for cutthroats. During 2005, however, very few age-1 YCT (those < 4 in) were captured, despite an abundant adult population (Figure 12). It is unclear why recruitment of age-1 fish was low during 2005, but water quality data collected by the US Forest Service from Soda Butte Creek near the YNP border show metal concentrations during 2005 exceeded water quality standards. It is possible that elevated metals in the water led to reduced survival of eggs and fry the previous year. During October, age-0 cutthroat trout were observed and appeared to have recently emerged from the gravel.

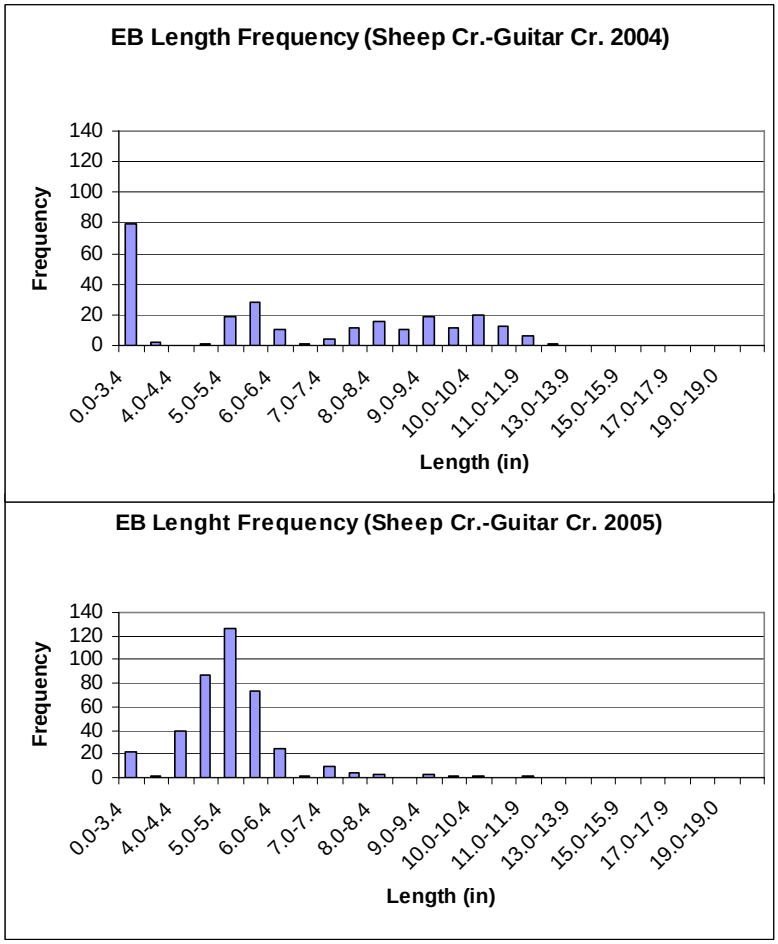

Figure 12. Length frequency of brook trout (EB) from 2004 and 2005.

Both YCT and brook trout numbers remained high in the next section downstream (Guitar to Silver Gate) (Table 8). Although measurements were not taken on fish in 2004 or 2005, fish were classified as either < 4 in or > 4 in during 2005. Only 26 YCT and 10 brook trout < 4 in were captured in 2005, suggesting that less spawning is occurring in this reach of stream than in the Sheep-to-Guitar area immediately upstream.

YNP fisheries crews perform annual population estimates in Soda Butte Creek. Their population section begins at the YNP border and extends downstream. During the 2004 survey, they also removed five brook trout in their section and in spot-electrofished areas downstream. In 2005, electrofishing was extended within YNP to the first highway bridge over Soda Butte Creek, approximately 3.5 miles (Figure 1). It was unclear from previous work how far into YNP brook trout extended. Our data, in conjunction with that from YNP, suggests brook trout decline precipitously from the park boundary downstream. Only 2 brook trout were captured from the Warm Springs picnic area downstream to the highway bridge. It is unclear, however, whether or not the expansion of brook trout has reached into the park, or whether habitat conditions are more favorable for brook trout outside the park.

Large numbers of brook trout present near Sheep Creek indicate colonization and use of the lower reaches as a spawning area. Sheep Creek was sampled in its entirety in 2004, and 2 electrofishing passes were made from Soda Butte Creek to the Highway 212 culvert. Only one

YCT (3.4 in) was captured. Sheep Creek upstream of Highway 212 to the falls was electrofished, and 9 YCT were captured ranging from 6-14 in. No brook trout and only one juvenile YCT were captured, so it is not likely that this tributary is being used for spawning by either species.

Woody Creek was also sampled from the bridge near Cooke City upstream approximately 0.3 miles. No brook trout were captured in the creek, but 76 YCT were, ranging in size from 4.7-13.7 in.

In 2004, a redd count was performed from Sheep to Guitar Creek to determine brook trout spawning. One brook trout redd was found and destroyed. During the redd survey, 2 small spring-fed tributaries were identified upstream of Guitar Creek—South Moose Meadow Creek on the south side and North Moose Meadow Creek originating approximately one-fourth mile upstream on the north side. Brook trout were seen in South Moose Meadow Creek, but none in the north creek. These streams were part of the electrofishing removals in 2005 when 29 brook trout were removed from South Moose Meadow Creek, and one brook trout from North Moose Meadow Creek. Warm Spring Creek in YNP was also sampled, and no brook trout were found. It appears from the data that the major tributaries to Soda Butte Creek do not contain brook trout, but the smaller spring-fed streams may be important brook trout habitats.

The last time these reaches of Soda Butte Creek and its tributaries were sampled was 1994. At that time, no brook trout were found downstream from Cooke City. Our data suggest the brook trout population has expanded greatly over the past decade and is no longer limited to the headwaters of the stream upstream of the McClaren Tailings. Natural reproduction has been documented downstream of Cooke City in the area between Sheep and Guitar creeks, and the offspring are migrating to other reaches of the Soda Butte Creek drainage. The increase in brook trout densities in this reach could be related to lower gradient and smaller substrate more suitable for spawning, or to the addition of the relatively pristine waters from the Sheep Creek drainage. The reason for greater fish density is unclear, but the data from 2004 and 2005 indicate this reach and that from Guitar Creek to Silvergate are where the majority of brook trout reside and where spawning is occurring. In order to mechanically remove brook trout, spawning must be eliminated. This has not occurred in two years of removal efforts, but substantial progress has been made in removing adult and juvenile fish, and in identifying the distribution of brook trout in order to direct future removal efforts. The reduction of brook trout numbers should also reduce their expansion into other areas within YNP. The current healthy status of the YCT population in the creek should give them a competitive advantage over the brook trout.

Miller and Sheep creeks. In 2005, an environmental assessment was prepared to introduce YCT into fishless areas of Miller and Sheep creeks (Figure 6 and 7). Both creeks contain suitable, but limited, habitat for cutthroats—approximately 2 miles in Miller Creek and 1.5 miles in Sheep Creek. Miller Creek has less water (2-5 cfs at low flows), a higher gradient, and has been more heavily impacted by mining than Sheep Creek. Though fish passage may be possible from Soda Butte Creek into Miller Creek, the high gradient may limit passage. Sheep Creek is relatively pristine and, due to the meadow reach of approximately 1 mile, has suitable habitat for cutthroat trout. Upstream passage from Soda Butte Creek is not possible because of Sheep Falls. The fires in 1988 burned the Sheep Creek drainage, but the riparian area is very healthy with abundant willows that overhang the creek. In September 2005, Miller Creek was stocked with 700 McBride-Lake-strain YCT, and Sheep Creek with 800.

Buffalo Fork Slough Creek

The Buffalo Fork of Slough Creek supports an abundant rainbow trout population. Fires in 1988 burned much of the watershed and led to a decline in the rainbow trout population due to erosion. Recent surveys suggest the rainbow population has recovered and the habitat conditions have stabilized, as described by Poore (1994). Downstream from the Montana-Wyoming line, the creek enters a narrow canyon where spawning and rearing habitat may be limited. Upstream of the state line in Montana, there are 2 large meadow reaches where there is adequate spawning and rearing habitat, and fish are abundant. Hidden Lake, a small, shallow lake in the upper meadow, also contains a self-sustaining population of rainbow trout. Recent events have focused some attention on the Buffalo Fork of Slough Creek because hybrid rainbow-cutthroat trout are becoming more abundant in lower Slough Creek. Further, recent genetic information places hybrid fish upstream of a barrier waterfall near the transfer station, where they have unrestricted access to Slough Creek in Montana, thus threatening one of the remaining strongholds for YCT in the state.

During August 2005, a crew inventoried the Buffalo Fork of Slough Creek and sampled Hidden Lake with the goal of determining the current status of the fishery and identifying any potential barriers. Rainbow trout 8-12 in were abundant in the upper and lower meadow reaches of the stream. This reach resembles a slow-moving lake because of the depth of water and lack of discernable current. Between the upper and lower meadows, the stream has several cascades and plunge pools, but no barriers were found. Several tributary streams enter the main creek in the meadow reaches and fish were observed in all tributaries. Downstream of the second meadow and just inside of YNP, two substantial falls (Figure 13) serve as barriers to fish passage (N 45.01253 W 110.17951). The falls are within 75 ft of each other. The upper falls is 12 to 15 ft tall with nearly a straight drop, and the lower falls is 6-8 ft tall, dropping straight into a very narrow, confined canyon. No survey data were collected upstream of the second meadow, but past data suggest rainbow trout are present upstream to the Forest Service Cabin, approximately 6 miles from the state line. The presence of a barrier within the system suggests cutthroat restoration might be possible in the creek.

Figure 13. Upper (left) and lower falls (right) on the Buffalo Fork of Slough Creek within Yellowstone National Park, Montana.

Boulder River

B-2 Section

The B-2 section is 6,040 feet long and is located approximately 8 miles downstream from the Natural Bridge near the mouth of the West Boulder River. It begins at the Boulder Forks FAS and has a steep-to-moderate gradient with wide, fast riffles where large rocks and boulders create numerous pockets of holding water, and pools and runs are widely spaced. The B2 section was surveyed in March 2000 (Poore 2000), and again in 2004, but no age data were reported. The section length was shortened 500 ft in 2004, to 5,540 feet, so the section now begins at the confluence with the West Boulder River.

The 2000 rainbow trout population estimates from B-2 (Figure 14, Table 9) increased 104% over 1997 estimates, and are the highest noted since it was initially monitored in 1981. Age-4 rainbows increased by more than 600%, from 72 to 485/mile, and age-5 from 81 to 297/mile, an increase of over 366%. The estimate for larger rainbows within the section is probably somewhat inflated, because many larger rainbows are only moving through the section to upstream spawning areas, and are seldom recaptured. Twenty-eight recaptures were recorded from 211 marked rainbows for a recapture rate of 13%. The standard deviations for the six size classes averaged 27%, indicating a less reliable rainbow estimate when compared to that of brown trout (Table 9).

Rainbow trout numbers declined 38 % from 2000 to 2004, but the estimate was still above the long-term average of 649/mile, and the only noticeable declines were age-4 and older fish. These decreased 195%, suggesting the rainbow estimate of 2000 was inflated for older fish. The 2004 estimate is better than that in 2000, even though still biased by migratory rainbows,.

From 2000 to 2004, the numbers of older (≥ age-3) brown trout decreased slightly, but the decrease was accompanied by stronger age-classes of 1- and 2-year-old fish. The brown trout population has been relatively stable since 1991, when fishing regulations placed more restrictive limits on fish harvest. Brown and rainbow trout populations in the B-2 section have fluctuated for many years (Figure 14), probably the result of variable spawning success and recruitment related to low fall flows. Flow fluctuations are particularly variable within the East and West Boulder rivers which are close to the B-2 section. The extent of movements, interchanges and seasonal use is not obvious.

Management goals from the Boulder River Management Plan call for maintaining 400 resident age-1 and older rainbow trout and approximately 1,100 age-1 and older brown trout per mile (a total of 1,500 total trout/mi). Although the ratio of browns to rainbows has recently shifted toward rainbows, the total number of trout within the section has not changed significantly. At 2,095 trout/mi, the overall management goal was exceeded in 2000 and again slightly in 2004 at 1,591 trout/mi. Even as total numbers decreased, numbers of larger rainbows and brown trout increased, indicating a positive response to restrictive fish-size limits.

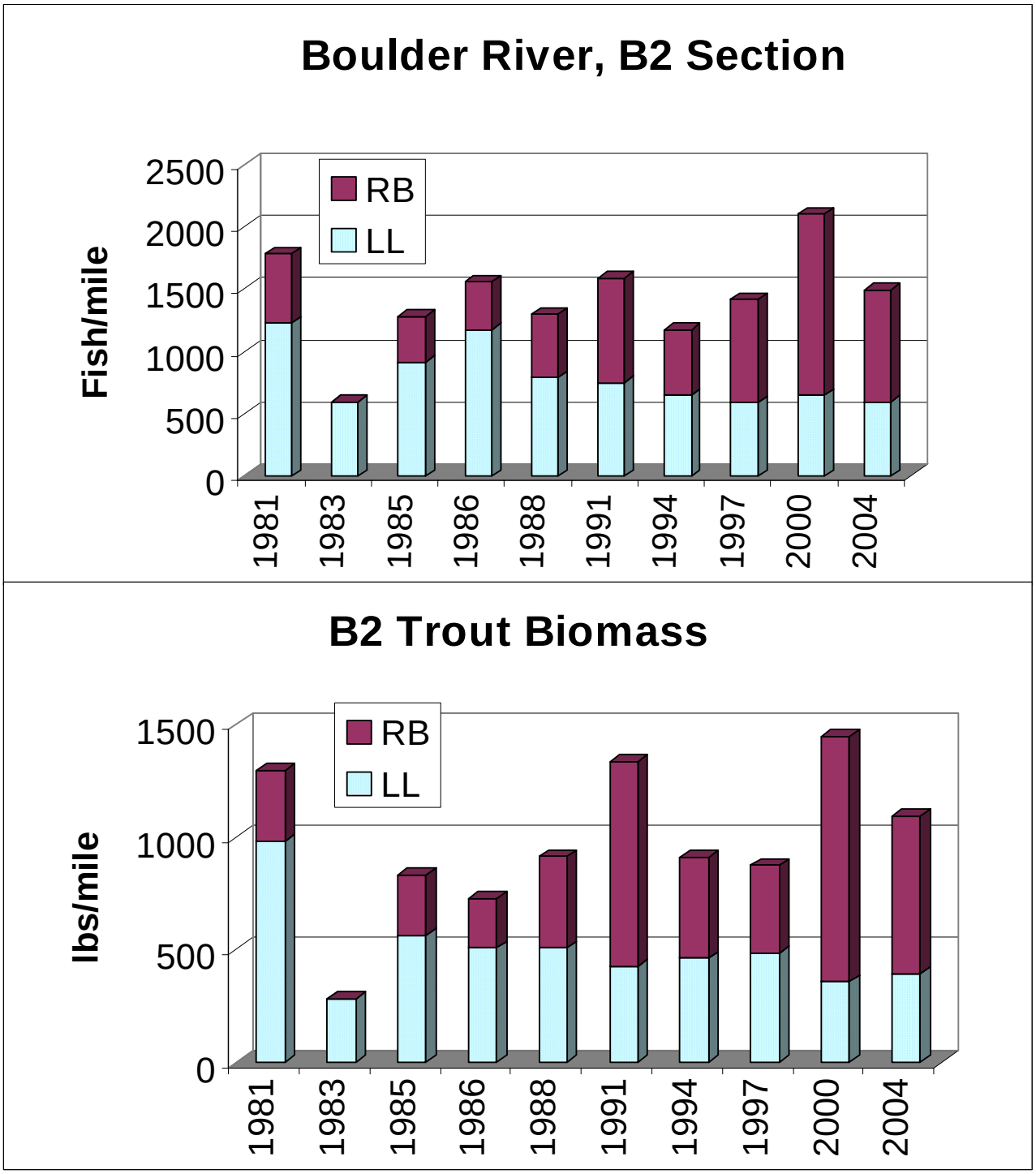

Figure 14. Trout population and biomass estimates from the B-2 Section of the Boulder River for rainbow (RB) and brown (LL) trout.

Table 9. Population data from the Boulder River, B-2 Section collected during March 2000 and 2004.

Species	Age Class	Average Length (in)	Average Weight (lb)	#/mi*	Biomass (lb/mi)
2000					
Brown trout					
	1	4.1	0.03	56 (10)	1.9 (0.4)
	2	7.6	0.16	82 (14)	12.8 (2.6)
	3	10.8	0.45	154 (16)	69.8 (9.4)
	4	14.3	0.94	227 (16)	212.7 (18.0)
	5	15.7	1.18	49 (9.1)	57.1 (11.2)
	≥6	16.5	1.34	2 (1.8)	2.4 (2.4)
			Totals	**596** (29**)**	**356.9** (23.5)
Rainbow trout					
	1	4.6	0.06	193 (27)	11.9 (8.2)
	2	7.6	0.16	202 (37)	32.4 (6.9)
	3	11.3	0.51	250 (31)	127.6 (22.3)
	4	14.2	1.00	485 (68)	482.5 (90.2)
	5	15.9	1.35	297 (98)	401.7 (160.9)
	≥6	16.1	1.40	24 (15)	32.9 (22.2)
			Totals	**1,449** (132)	**1,088.9** (187.4)
2004					
Brown trout					
	1	3.4	0.02	108 (31)	2.2 (0.6)
	2	7.1	0.12	211 (46)	25.9 (6.0)
	3	11.6	0.56	102 (15)	57.0 (9.3)
	4	14.8	1.09	246 (18)	268.3 (22.3)
	≥5	16.4	1.43	27 (9)	38.3 (11.1)
			Totals	**694** (61**)**	**391.6** (27.3)
Rainbow trout					
	1	3.3	0.02	107 (22)	1.8 (1.4)
	2	8.2	0.22	175 (22)	39.3 (6.5)
	3	13.1	0.80	298 (32)	238.7 (33.3)
	4	15.6	1.32	289 (42)	380.9 (77.7)
	≥5	16.6	1.61	28 (12)	44.8 (21.0)
			Totals	**897** (63)	**705.5** (87.4)

*****Numbers in parentheses represent the standard deviation of the estimate.

Spawning Evaluations at Beaver Meadows Ranch

A 4,600-ft, large-scale, stream-restoration project was proposed by Water Consulting Inc. (WCI) on the Beaver Meadows Ranch (BMR), located immediately downstream of the Natural Bridge Falls. It called for streambank stabilization along vital spawning habitat for resident and migratory trout in the Boulder and Yellowstone rivers. Here, the river is a C3/C4 channel type (Rosgen 1996) consisting of a meandering channel in a wide valley bottom and gravel/cobble substrate. The low gradient and abundant gravels are ideal for trout spawning. The large-scale scope of the project was eventually shortened to one high, eroding bank approximately 1,000 ft in length. Two large rock weirs, a hook "J" weir, and a bankful bench were constructed along the bend in the river, and root-rap was installed. There was concern that these streambank stabilization methods could cause increased velocities and lead to the scouring of spawning gravels, so a monitoring program was established prior to construction that included spawning counts (WCI. 2002, 2003). FWP agreed to help conduct these to identify critical spawning areas and ensure data accuracy. Rainbow and brown trout redd counts were conducted in the spring and fall beginning in 2001. The area surveyed and maps showing redd locations have been summarized in a previous report (Poore 2000, Olsen 2003). The project was completed in the summer of 2001 with spring redd counts conducted before project completion, and fall counts after. While the intent of this monitoring was to determine project impacts, it also provided information on spawning numbers, and these were correlated back to population statistics collected at B-2 section of the Boulder River, and the Big Timber section of the Yellowstone River.

Rainbow Trout. There are 37 redd locations on the 3-mile reach of river surveyed. Most are associated with side channels, pool tailouts, or shallow, gravely riffles. The redd sites immediately affected by the project include 4T, A7, and A6 (downstream of the project); 3T in the immediate project site; and 2T (upstream). In the first spring runoff to affect the project site during 2002, spawning occurred before runoff with noticeable changes downstream (Figure 15). In 2003, rainbow redd counts dramatically increased at 4T and A6, likely due to accelerated flows scouring the bed and banks and depositing this material. Since 2003, redd counts have steadily declined in these areas, and overall (Figure 16). It is difficult to determine if the project is impacting spawning areas downstream, as the immediate project area was used very little for spawning. Redds were present in 3T the spring after project completion, most likely as a result of loosened bed material created by the project construction. Accelerated flows at the project site have substantially narrowed the channel and scoured the smaller substrate to a size suitable for spawning. It does not appear that 2T, immediately upstream of the project area, has been substantially affected by the project, even though it has the most potential for negative impact. The accelerated flows and increased scour associated with the project appear to be causing degradation to the streambed. This degradation could accelerate erosion at 2T, one of the prime spawning areas in the Beaver Meadows Ranch.

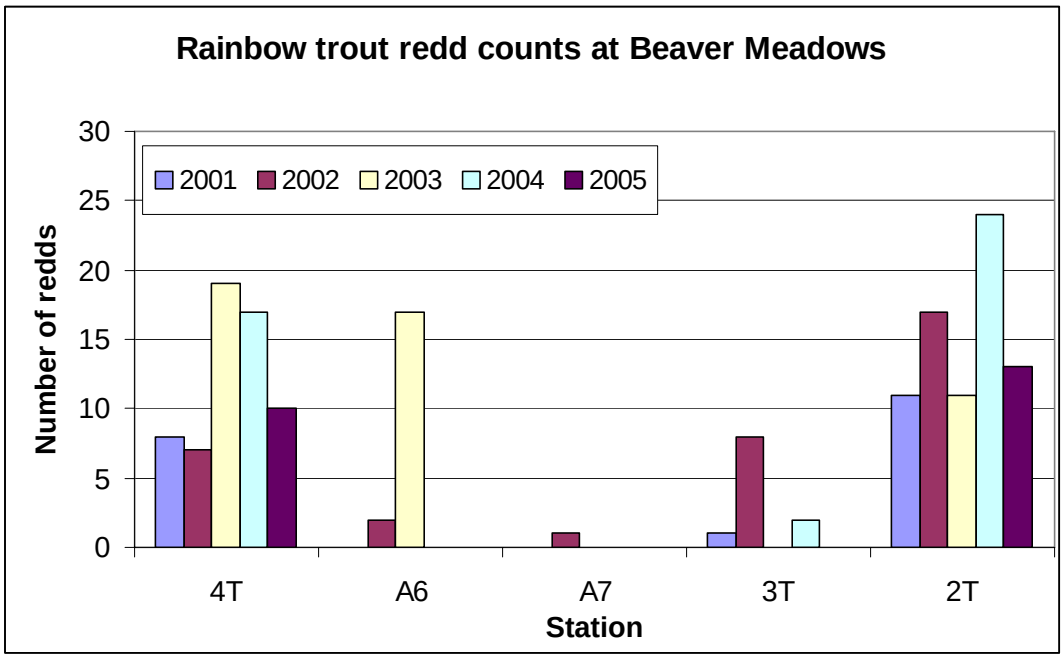

Figure 15. Rainbow trout redd counts from Beaver Meadows, Boulder River, that are directly affected by the 2001 bank stabilization project.

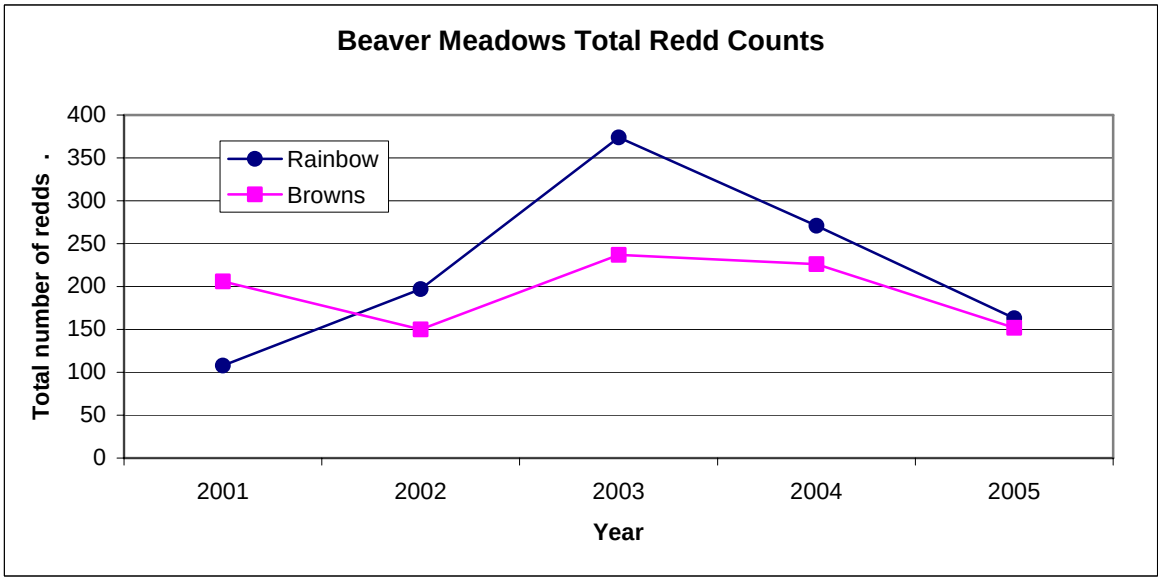

Figure 16. Total trout redds from spring (rainbow) and fall (browns) from the Beaver Meadows Ranch, Boulder River.

Brown Trout. Like rainbows, brown trout redd numbers increased in sites immediately downstream of the reconstructed bank (Figure 17), then steadily declined after 2003. Total redd counts of brown trout have not declined as much as rainbows since 2003 (Figure 16). This suggests the reduction in brown trout redds downstream is not related to the decrease in total numbers of fish, but to poor quality habitat. Immediately upstream of the project at 2T, brown trout redd numbers declined by more than 50% after the bank stabilization was complete. It is not clear if different hydrologic conditions exist in the fall and spring to cause the decline, but it is evident that after the project, brown trout use of this area decreased substantially.

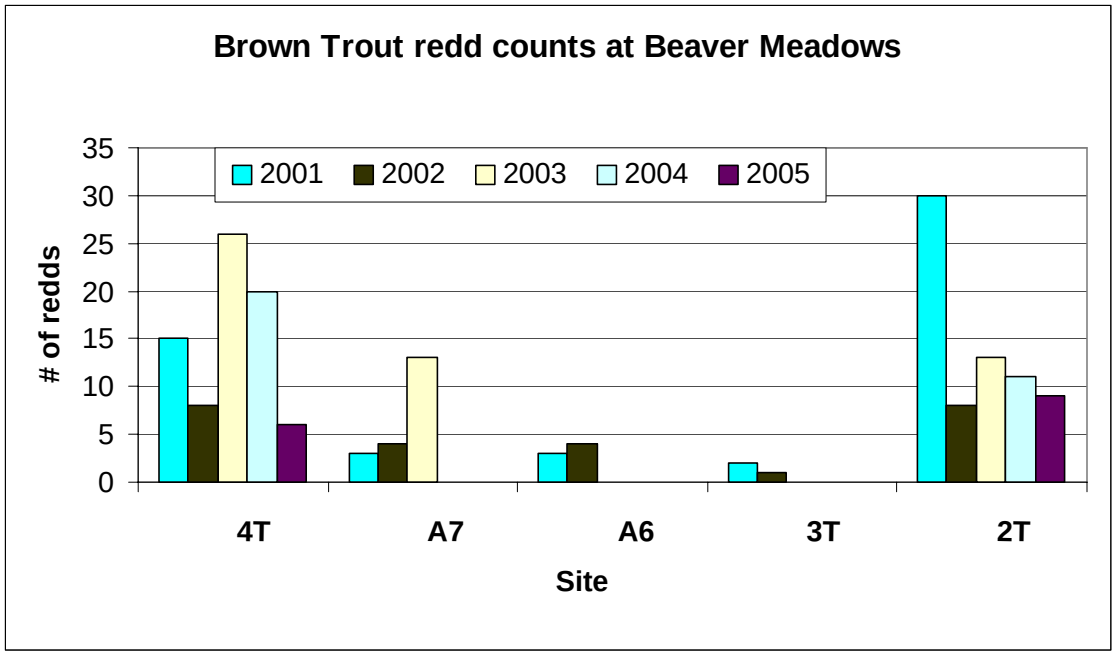

Figure 17. Brown trout redd numbers in the area immediately affected by the 2001 bank stabilization project at Beaver Meadows Ranch, Boulder River.

Some correlation exists between total redd numbers observed in the Beaver Meadows Ranch spawning area, and population data collected in B-2 and the Yellowstone River. Brown trout data gathered from B-2 in 2004 suggests a 50% increase in the number of age-1 fish, which correlates to the peak in brown trout redd counts observed in 2003. Similarly, the 2003 rainbow trout spawning peak at Beaver Meadows correlates with the abundant age-1 and age-2 rainbows in the Big Timber Section, and in areas shocked downstream in subsequent years in the Yellowstone River.

Main Boulder Tributary Surveys

In the summer of 2003, many of the tributaries to the main Boulder River, upstream of Natural Bridge Falls, were surveyed to determine the status of cutthroat and other trout in the upper Boulder and its tributary streams (Figures 18 and 19). Most of the sampling in the tributary streams occurred within 1 mile of the confluence of the main river, except in Meatrack and Great Falls creeks where surveys were farther upstream. Electrofishing was performed at each site over distances between 100-250 yards. Rainbow and brook trout dominate in tributaries downstream of Four Mile Creek (Table 10), while cutthroats, rainbows and hybrids are more common upstream. No brook trout were found upstream of Four Mile Creek. Tributary streams not sampled during 2003 include Contact, Graham, Hawley, West Chippy, Elk, Copper, and Sheep creeks, and the Main Boulder upstream of East Fork.

Four Mile and Meatrack creeks had greater fish densities than any other creeks sampled in the drainage (Table 10). Rainbow trout are common in Four Mile Creek, from its headwaters at Prospect and Silver lakes, to its confluence with the Boulder River. Cutthroat trout were introduced into Meatrack Creek, a tributary of Four Mile Creek, in 1979, and are now self-sustaining. The habitat in upper Meatrack Creek consists of low gradient meadows with frequent pools and excellent spawning gravels. The lower 1.5 miles is high gradient and dominated by

large boulder cascades. In the past, this high-gradient reach has precluded passage of rainbow trout from Four Mile Creek. Genetic samples were taken in Four Mile and Meatrack creeks. Only the Meatrack samples were analyzed and they were 99% pure YCT and 1% rainbow trout. Genetic analysis suggests the 1% rainbow genetic contribution was the result of fairly recent hybridization. This recent hybridization indicates that the high gradient reach is now passable by rainbows which could threaten the largest and most prolific population of self-sustaining cutthroat in the upper Boulder River drainage.

A subsequent survey was conducted in Meatrack Creek in the summer of 2005, and electrofishing in lower Meatrack Meadows found many hybrid fish. Genetic samples were not collected, but it appears that rainbow and hybrid trout are becoming very common in Meatrack Creek. In lower Four Mile Creek, a fish passage investigation was also initiated during 2005 to determine if fish from the Boulder River and lower Four Mile Creek could swim upstream to the confluence of Meatrack Creek. This reach has a very high gradient, but no obvious barriers. Fifty-one fish from Meatrack Creek and 64 fish from Four Mile Creek were captured and released downstream approximately 0.5 miles. Prior to release, rainbow, cutthroat and hybrid fish were adipose fin-clipped. In Four Mile Creek, fish were released downstream of the cascade section near the Boulder River Road crossing, approximately 50 yards upstream from the confluence with the Boulder River. In the summer of 2006, the section of stream from the Boulder River Road upstream to Meatrack Creek will be electrofished. Any adipose fin-clipped fish found at that time will indicate the cascades are passable.

The discovery of hybrids in Meatrack Creek led to a proposal to protect the cutthroat population from further hybridization. A suitable location for the construction of a barrier exists in Meatrack Creek, approximately one-fourth mile upstream of its confluence with Four Mile Creek. The stream is within the Absaroka-Beartooth Wilderness area with limited access, however, and construction would be extremely costly, logistically difficult, and could be politically and socially unacceptable. To protect the cutthroat population in Meatrack Creek, therefore, the project would have to replace the existing rainbow fishery in Four Mile Creek with a cutthroat fishery. It would begin at Silver and Prospect lakes and eventually extend downstream to the confluence of the Boulder River, including portions of Meatrack Creek. If lower Four Mile Creek proves to be passable to fish, barrier construction would have to be outside of the wilderness area, near the Boulder River confluence.

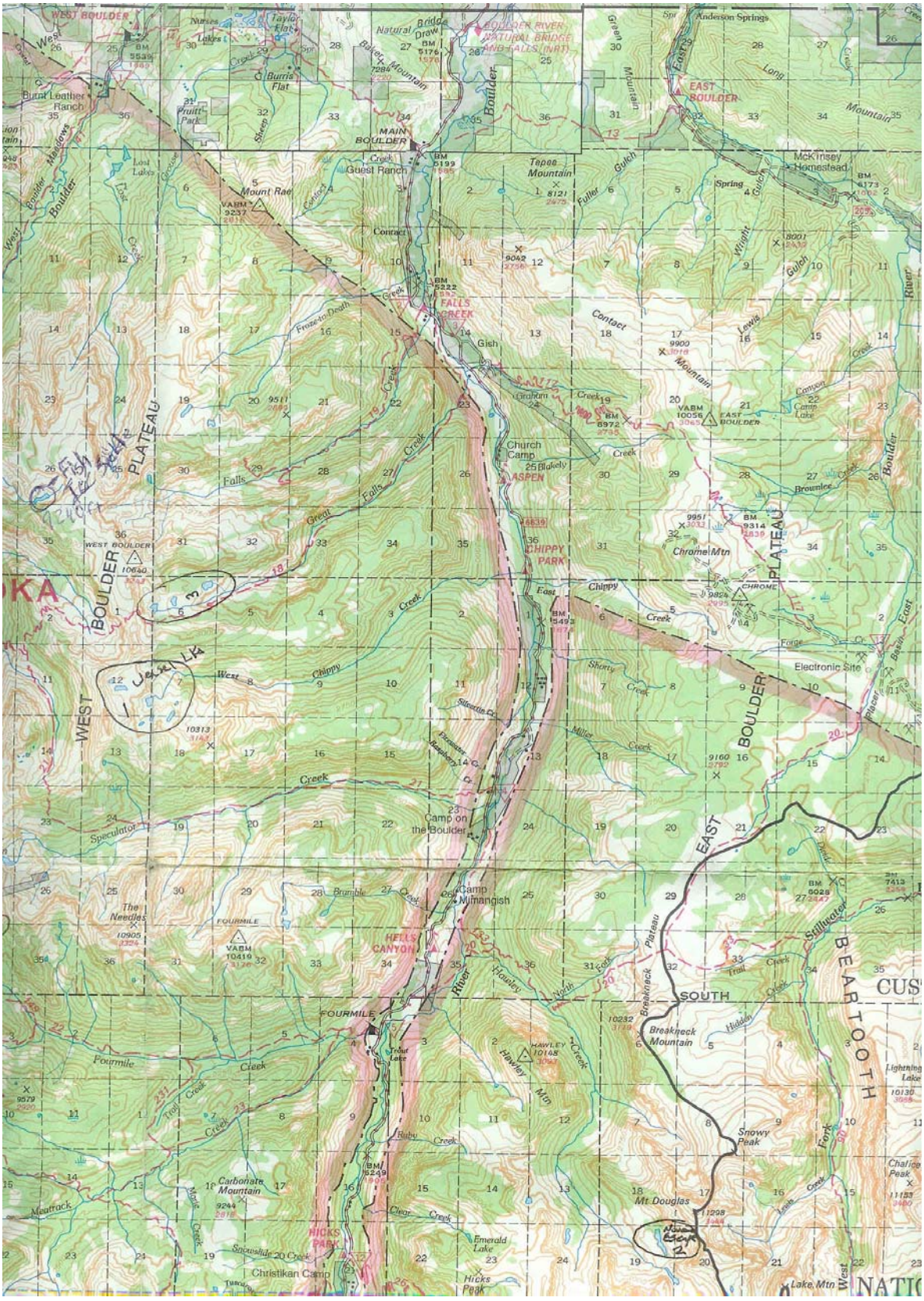

Figure 18. Map of Boulder River from the Natural Bridge to Four Mile Creek showing sampling sites.

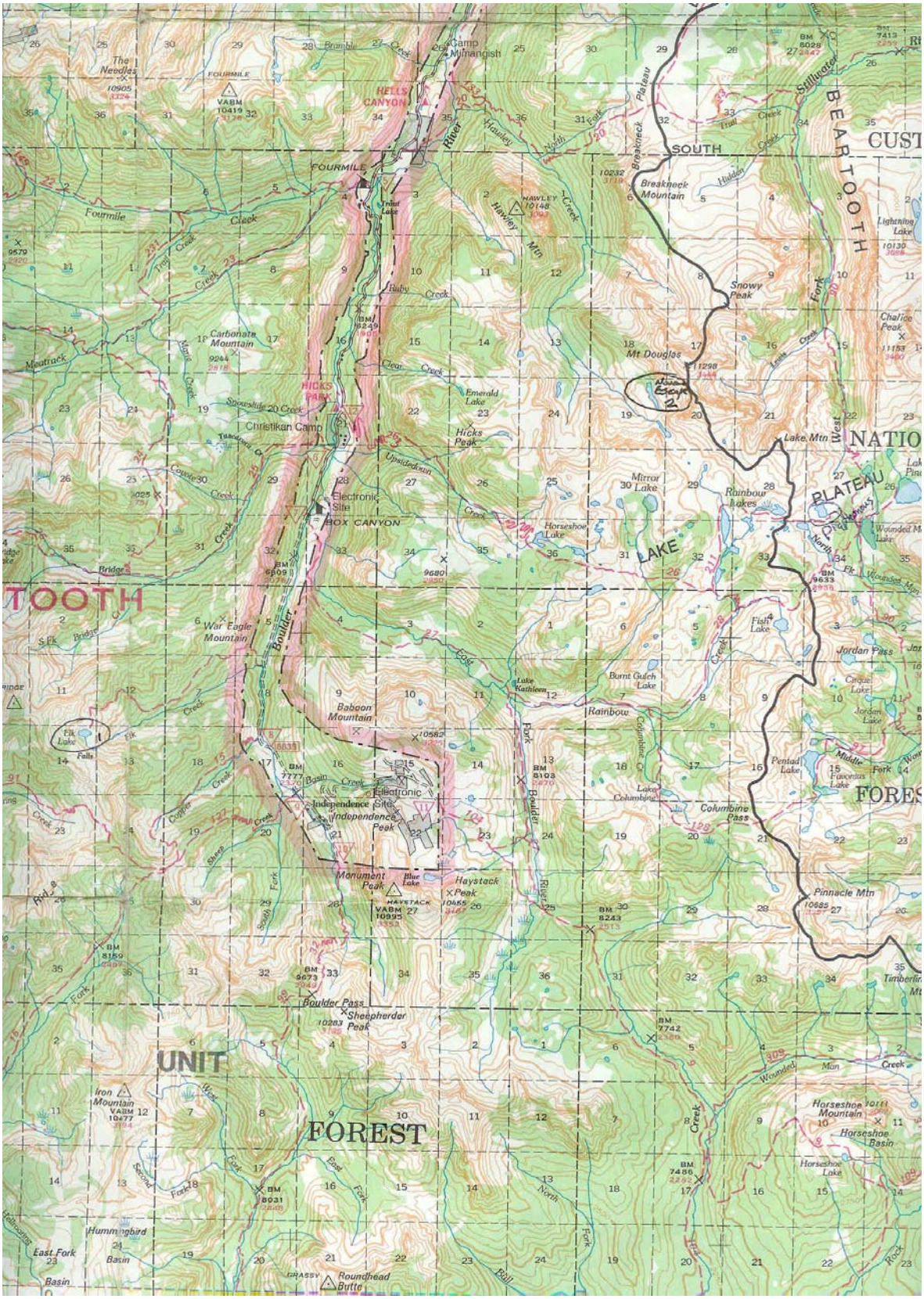

Figure 19. Map of Boulder River from Four Mile Creek to its headwaters showing sampling locations.

Table 10. Fish population data from tributaries to the Boulder River upstream of Natural Bridge Falls.

Stream	Yellowstone cutthroat		Rainbow trout		Hybrids		Brook trout	
	# (#/mi)	Length (in)	#	Length (in)	#	Length (in)	#	Length (in)
Froze to Death Creek	0		5	5.8 (4.1-7.1)	0		6	6.4 (4.7-8.3)
Falls Creek	0		7	6.7 (4.4-8.0)	0		5	4.7 (3.5-5.3)
Great Falls Creek (a)	0		8	5.7 (3.2-8.1)	0		0	
Great Falls Creek (b)	0		0		0		0	
Blakley Creek	0		9	3.0 (2.4-4.3)	0		2	5.9 (5.1-6.7)
East Chippy Creek	0		1	8.7	0		0	
Speculator Creek	0		5	5.5 (5.0-6.3)	0		12	6.0 (4.3-7.3)
Bramble Creek	0		0		0		0	
Four Mile Creek	62	5.1 (2.6-9.2)	68*	5.8 (2.1-10.1)	0		0	
Meatrack Creek	199 (2108)	6.3 (1.9-10.8)	0		0		0	
Clear Creek	0		0		1	4.6	0	
Ruby Creek	0		0		3	4.4 (1.9-6.1)	0	
Bridge Creek	7	5.6 (3.7-8.8)			0		0	
Upside Down Creek	20	6.6 (3.0-8.7)	0		0		0	
East Fork Boulder	4	8.2 (6.9-9.3)	3	7.0 (6.1-8.7)	2	7.7 (6.3-9.1)	0	

*hybrid trout were grouped with rainbow trout

East Boulder River Cooperative Monitoring

In August 2003, Placer Basin, B-4, 5 and 6, and Elk Creek were sampled in the East Boulder River drainage (Figure 20). From the headwaters in Placer Basin to below the mouth of Elk Creek, two-pass electrofishing was used to estimate abundance at these five sites. The work was done in cooperation with Montana Trout Unlimited as part of their agreement with the Stillwater Mine.

The B-4 Section, located immediately downstream of the confluence of Elk Creek, is the farthest downstream site sampled on the Boulder River. Several large irrigation diversions exist upstream of the B-4 section, so the stream is partially dewatered. Unlike other areas farther downstream, however, this reach always has sufficient flows. Like the 2001 estimate, the population in this portion of the stream contained nearly equal proportions of brown and rainbow trout (Table 11). One YCT was also captured during sampling. According to the population estimate, both brown and rainbow trout populations have decreased approximately 40% since 2001—rainbow, 1035/mi, and brown, 1171/mi. The reliability of the 2003 estimate, however, is questionable due to inefficient removal, particularly for brown trout. Ideally, a third electrofishing pass should have been performed to improve accuracy, but was not possible. Despite that, it is apparent from the data that trout numbers have declined in the B-4 section. All age classes of brown trout were present in the creek from age 0 to age 4+. No age-0 rainbow trout were captured at B-4, but age-1 through age-4+ fish were well represented. Fluctuations in trout numbers in B-4 may be related to dewatering and lack of connection to the main Boulder River during late summer.

The B-5 Section of the East Boulder begins at the downstream end of the USFS campground and has a lower gradient than either B-4 or B-6. It is located upstream of all irrigation diversions. A three-pass removal during 2003 revealed brown trout numbers similar to those estimated in 2001—rainbow, 3122/mi; brown, 829/mi (Table 11). Rainbow numbers, however, decreased by 62%. Despite that, they are nearly three times more abundant than brown trout in this area. Brook trout are present at the site, but too few were captured for a reliable population estimate. Like the B-6 site, all age classes of trout were well represented in the sample, and the population appears healthy and stable. In the past, this section has seen wide fluctuations in species composition and population size, with great variation between spring and fall (Gillin 2003).

The B-6 Section, located at the East Boulder mine downstream of the confluence of Dry Fork, was a higher gradient than all other sections sampled on the creek. Large boulders dominate the stream substrate, and riparian vegetation is predominantly coniferous forest as opposed to the cottonwood/willow vegetation in B-4 and B-5. In 2003, the dominant trout species was rainbow, followed by browns, and no cutthroat or brook trout were captured (Table 11). Section B-6 was the only site in the lower river with no noticeable decline in the fish population estimate from 2001 to 2003 (rainbow, 1933/mi; brown, 767/mi).

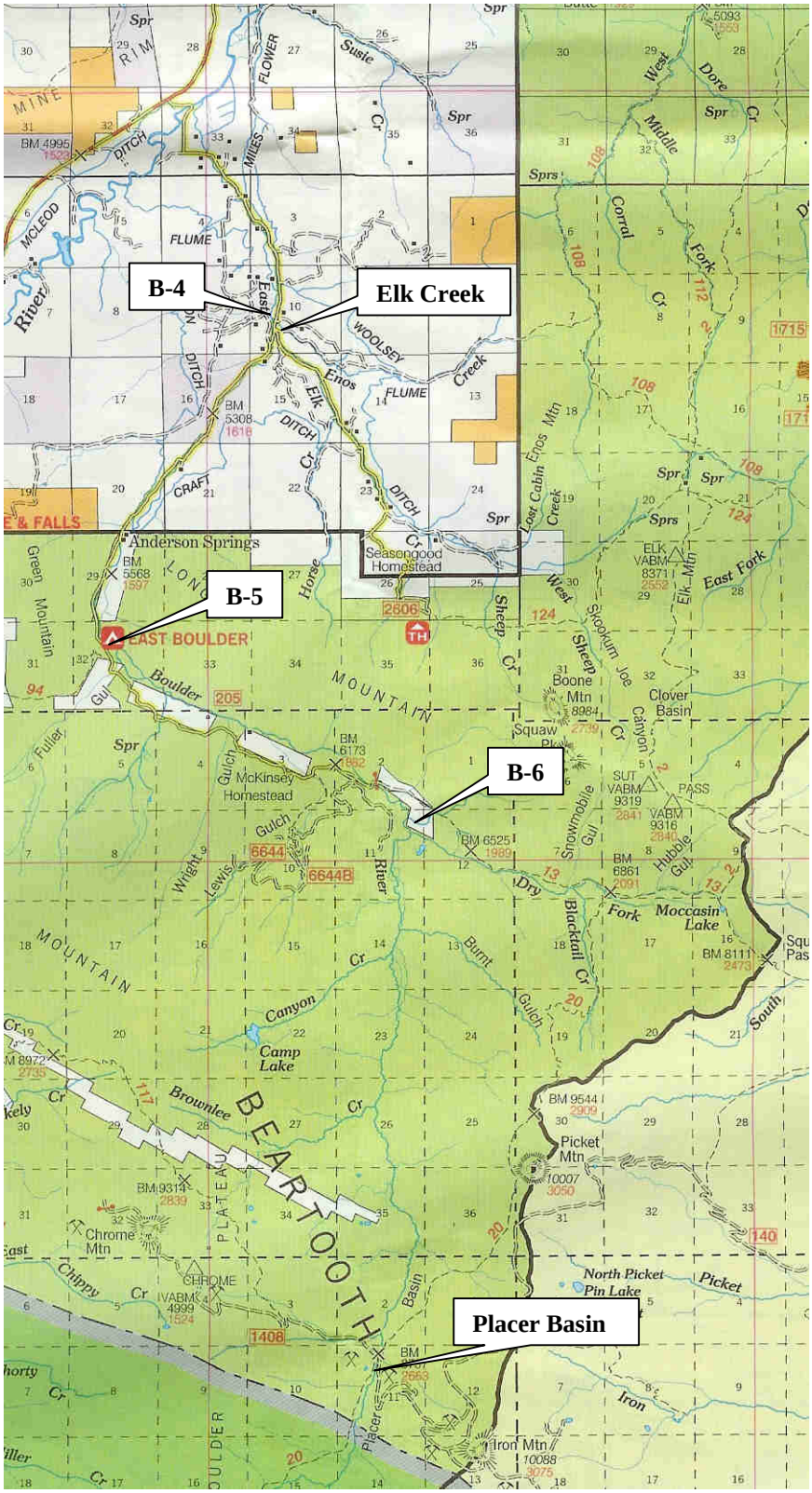

Figure 20. Map of the East Boulder River watershed showing monitoring sites sampled in 2001.

Table 11. Summary of fish population parameters collected in the East Boulder River watershed during August 2003.

Site	Species	n*	#/mi	95% CI	Average length (in)	Average weight (lb)
B4						
	Brown	63	762	273-1250	8.9 (2.6-17.1)	0.41 (.0.1-1.92)
	Rainbow	67	664	433-894	7.1 (4.1-13.0)	0.19 (0.02-0.78)
	Cutthroat	1	-	-	8.1	0.33
		Total	**1426**			
B5						
	Brown	29	164	135-192	9.2 (3.0-17.1)	0.43 (0.01-1.92)
	Rainbow	163	1167	901-1431	6.2 (2.8-11.1)	0.12 (0.01-0.48)
	Brook	18	-	-	5.9 (4.2-7.7)	0.09 (0.03-.018)
		Total	**1331**			
B6						
	Brown	79	845	810-880	3.5 (3.0-10.5)	-
	Rainbow	177	2028	1876-2179	6.1 (2.6-10.1)	-
		Total	**2873**			
Placer Basin						
	Cutthroat	80	1001	910-1093	5.3 (3.1-8.8)	-
Elk Creek						
	Brown	14	-	-	4.8 (2.9-7.4)	0.05 (0.01-0.12)

* The symbol n represents the number of fish captured during the survey. CI represents the 95% confidence interval of the population estimate.

The uppermost site in Placer Basin, upstream of the East Boulder Mine complex, supports an excellent headwater population of pure YCT. The site was shortened from 1,100 to 450 feet in 2003 because the habitat is relatively homogenous, the stream small, and fish numbers high. No weights or scale samples were collected in 2003. There were just over 1,000 cutthroat/mi in 2003 (Table 11), compared to the 1,367 fish/mi estimate in 2001, and the size range was 3.1-8.8 in. Fish from all size classes were well represented in this healthy, stable population. Due to large numbers of cutthroat in Placer Basin, the creek has been used to supplement other wild populations of YCT, such as those in Bad Canyon Creek.

Boulder River Ditch Fish Rescues

Fish rescue operations continued on the Lamp-Nelson and Dry Creek Canal ditches from 2003-2005. Plans to install a fish screen on the Lamp-Nelson Ditch were never completed, but the ditch users signed an agreement with Trout Unlimited to develop off-ditch stock water sources. On October 1, 2005, the ditch, which flowed between 15-20 cfs in fall and winter, was closed, leaving more water in the river. Fish rescue efforts continued during the fall (Table 12). The non-trout species collected included mountain whitefish, mottled sculpin, white sucker and

longnose dace. One 10.0 in YCT was also captured in the ditch in 2003 and released back into the river. In fall 2005, additional fish were captured from the Dry Creek Canal, which originates on the same property as the Lamp-Nelson Ditch. Altogether, 112 rainbows, 93 browns, and 1 YCT were captured and released back into the Boulder River. The Dry Creek Canal is the largest ditch on the Boulder River, and many fish were likely not captured during 2005 due to high flows.

Table 12. Fish captured from Lamp-Nelson Ditch and returned to the Boulder River during fall 2003-2005.

Year	Browns	Rainbows	Other fish (4 species)
2003	118	25	419
2004	245	161	658
2005	226	120	204
Totals	589	306	1281

Stillwater River

Moraine Section

The 3,300-ft Moraine Section is located 2.7 miles below the mouth of the West Fork of the Stillwater River and about 8 miles downstream from the Stillwater Mine Complex. Because it begins at the Moraine Fishing Access Site and extends downstream, this reach receives relatively heavy fishing pressure, and is one of two long-term fish population monitoring sites located along the Stillwater.

In March of 2000 and 2003, population estimates were performed in the Moraine Section (Table 13, Figure 21). In 2000, 257 brown trout were marked, 230 were captured, and of those, 78 were recaptures. In 2000, the brown trout estimate of fish age-1 and older increased by 40% from the 1998 estimate of 1,641/mi (Table 13). This brown trout estimate is the largest since data have been collected at the site (Figure 21). The greatest increases in numbers were for age-1 (54%) and age-4 (69%) fish. The overall biomass estimate increased slightly from 549 lb/mi in 1998 to 631/mi in 2000, and was also the highest observed in the history of the site.

In 2003, 289 browns were marked, 256 captured, and 78 were recaptures. The brown trout estimate in 2003 changed somewhat from 2000 (Table 13). The overall estimate decreased by 26%, but the major decrease in numbers occurred in age-1 and age-3 classes, which were the most abundant in 2000. Despite the decline in total population numbers, the estimate was slightly greater than the historical average (Figure 21).

During spring electrofishing on Moraine, large numbers of captured rainbows are migrating to spawning areas farther up the Stillwater River. Because these fish are only passing through, they are seldom recaptured. Moraine is a rearing area for small rainbows, and most leave the section prior to reaching maturity. In 2000, of the 89 rainbows marked, 63 were captured, and only 12 of those were recaptures. The rainbow trout estimate suggests the population has increased by 70% from 1998, from 277/mi to 930/mi.

Table 13. Population data from the Stillwater River, Moraine Section collected during March 2000 and 2003.

Species	Age Class	Average Length (in)	Average Weight (lb)	#/mi*	Biomass (lb/mi)
2000					
Brown trout					
	1	3.5	0.03	1277 (179)	14.4
	2	6.6	0.11	441 (56)	8.3
	3	10.3	0.40	633 (46)	24.3
	4	12.9	0.70	361 (36)	31.0
	≥5	14.8	0.99	22 (9)	9.7
			Totals	**2765** (196)	**631.1** (43.8)
Rainbow trout					
	1	2.8	0.02	305 (73)	6.6
	2	4.8	0.08	154 (38)	12.3
	3	10.5	0.44	152 (24)	66.7
	4	14.2	0.92	226 (93)	207.9
	≥5	14.3	0.93	93 (46)	86.8
			Totals	**930** (135)	**380.4** (108.7)
2003					
Brown trout					
	1	3.6	0.02	980 (143)	18.4
	2	6.5	0.11	384 (45)	41.3
	3	9.9	0.35	408 (35)	141.2
	≥4	13.0	0.71	418 (39)	296.1
			Totals	**2190** (159**)**	**497** (39.8)
Rainbow trout					
	1	2.6	0.01	178 (53)	0.60
	2	7.3	0.21	168 (51)	25.2
	3	10.1	0.42	204 (106)	64.5
	≥4	10.1	0.42	83 (48)	28.1
			Totals	**632** (138)	**156.0** (75.0)

*Numbers in parentheses represent the standard deviation of the estimate.

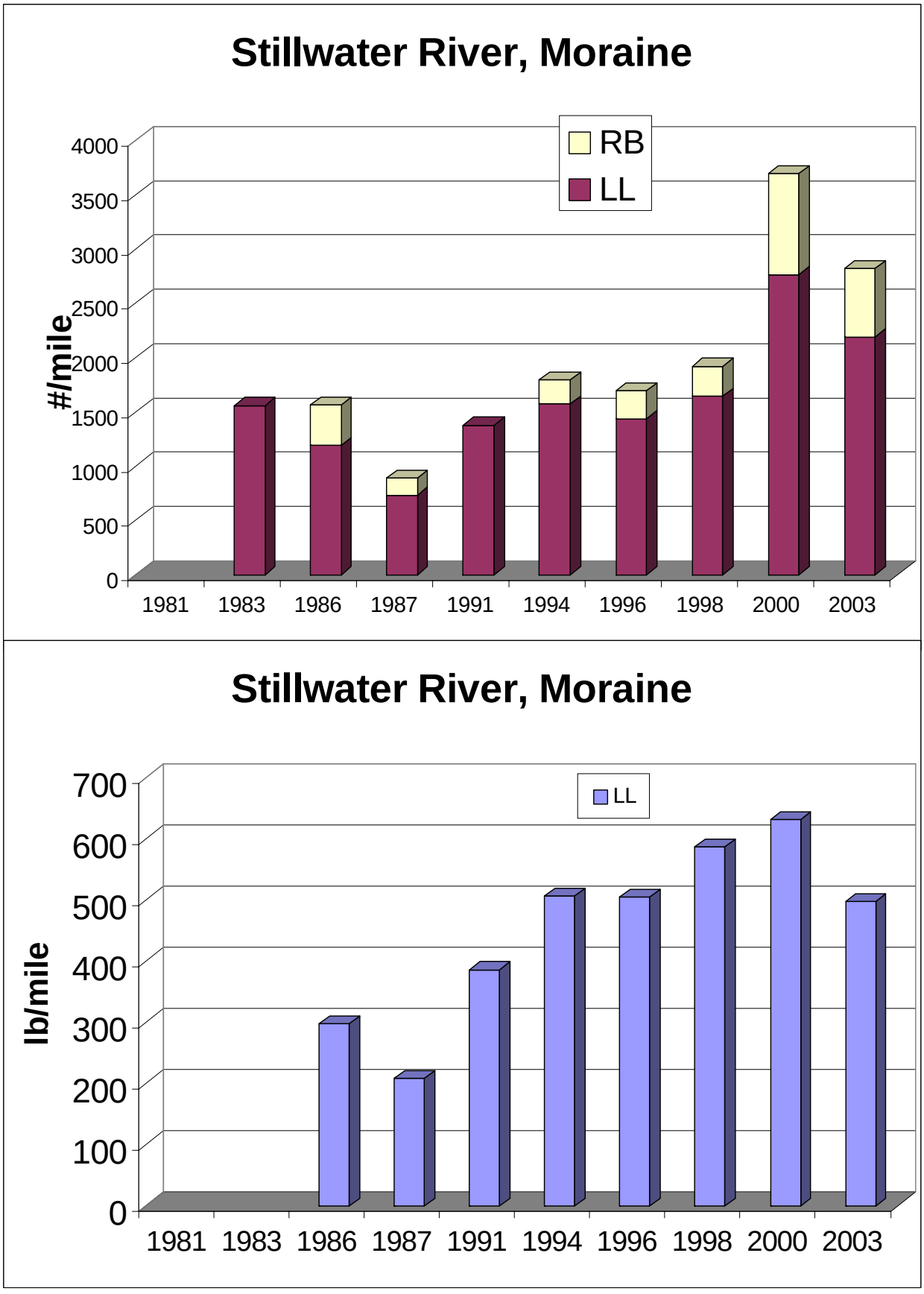

Figure 21. Trout population and biomass estimates from the Stillwater River, Moraine Section.

In 2003, 68 rainbows were marked, 48 were captured, and only 8 of those were recaptures. The population estimate was 632/mi. Although rainbow trout numbers decreased by a third from 2000 to 2003, total numbers were approximately double the historical average. Similar increases in rainbow populations in the past 7 years have occurred in the Absarokee, B2 and Fox sections. It is possible that the prolonged drought has favored rainbow trout over brown trout.

Management objectives for this river reach, require maintaining 1,000 to 1,500 age-1 and older brown trout per mile. Of that number, 100 to 150 fish must be over 13 in. The 2000 and 2003 estimates were within the objectives, with over 2,000 brown trout/mi and 380-415 of those fish over 13 in. The increased size and numbers of brown trout may be the result of more restrictive fish limits put in place in 1990, when the possession limit was reduced from five fish (only one over 18 in) to two fish (only one over 13 in). The Stillwater River Management Plan, which calls for maintaining 200 to 400 age-1 and older rainbow trout per mile, and protecting larger rainbow trout during spawning, has been met for this river reach.

Absarokee Section

The Absarokee Section, established in 1992, is a 4,750-ft section beginning at the confluence of Rosebud Creek and the Stillwater River and extending downstream approximately 100 yards to the abutments of the "Old Iron Bridge." Fishing pressure is high in this section as a result of abundant public access to the river, so it serves as a good indicator of the potential impacts of angling on the fish population in the Stillwater River.

The brown trout population in the Absarokee Section has remained relatively stable since 1998 (Figure 22). The river was surveyed in fall 2003 and 2005. In 2003, 266 browns were captured and marked, 268 were captured on the recapture run, and 44 of those were recaptures, for a total population estimate of 1,932/mi (Table 14). This estimate is nearly identical to the 2001 estimate (Olsen 2003). There were, however, some substantial changes in the age-class distribution of fish between years. From 2001 to 2003, the number of age-2 fish increased 34% while age-3 fish numbers decreased by 52%. The total number of brown trout has changed very little in the Absarokee section, but the biomass of brown trout in the section has steadily increased from 1992 to the present (Figure 22). An increase in fish biomass along with stable fish numbers indicates that the average size of brown trout in the section is increasing.

No age data are available for the Absarokee Section from 2005. A size-based estimate was used to determine the current population. During the marking run, 362 brown trout were captured, 274 captured during recapture, and 64 of those were recaptures. The brown trout estimate for 2005 was 1,751/mi, a 10% decrease from the 2003 estimate. No major changes are evident in the size structure, but further analysis will be done when the age data are available. Similar to 2003 results, the biomass estimate for brown trout in the Absarokee Section rose from 2003-2005.

In 2003, 233 rainbows were marked, 254 were caught on recapture. Forty-two of those were recaptures, which accounted for 17% of all rainbow trout marked. By comparison, in 2001 the numbers were 258, 240 and 43, respectively (Olsen 2003). Total rainbow numbers declined by 3% from 2001 to 2003 (Figure 22). Numbers of all age classes of fish were similar to those observed in 2001. Slight decreases in age-2, age-4 and age-5+ fish were noted, but overall the

population appeared to be stable. Additionally, 2 Yellowstone cutthroat trout were captured in the section for the first time: 9.5 in 0.41 lb, and 9.6 in and 0.39 lb.

Total rainbow trout numbers increased by 32% to 2602/mi in 2005. Although age data are not currently available, the greatest increase in fish numbers occurred in the size class between 5 and 8 in. This size group corresponds well to the age-2 class from other years.

Age-1 numbers decreased from 750/mi in 1998 to 69/mi in 2001. Despite that, subsequent declines in age-3 fish during 2003 or age-5+ (i.e., those fish over 13 in) were not observed. In 1992, there were 2,925 age-1 rainbow trout/mi, and the high number of this age class of fish was attributed to migration from upper areas of the river to lower sections and/or to the Yellowstone River. Many migratory populations of trout are known to leave rearing areas at age 1 and 2 and move to more suitable adult habitats, such as those in the lower Stillwater and Yellowstone rivers. Quite possibly, by sampling the section earlier in September of 1998, 2001, and 2003, the population data preceded the migration of these younger fish through the section, and led to a lower estimate. It appears the later sampling in 2005, when fish were marked September 19 and recaptured October 19, may have coincided with this migration time. The timing of the 2005 estimate was similar to that in 1992 when estimates for juvenile rainbow trout were high. The migratory life history of many juvenile fish in the Absarokee section explains, in part, the trends in the data collected. The large fluctuations in younger age classes of fish and later increases and decreases in the older age classes suggest many of the juvenile fish in this section migrate to other locations, and many are migrating in late September and October. It is likely that most of the migratory portion of the population leave the section at age 1 or 2, which explains why fluctuations in these age classes of fish are not apparent in later years.

Management objectives from the Stillwater River Management Plan for the lower river reach call for maintaining 500 to 1,000 age one and older brown trout per mile, with 100 to 150 of these fish over 13 in. The latest population estimates of brown trout in this river reach exceed these criteria with 1700-1900/mi, of which 131-443 are over 13 in. The plan also calls for maintaining 2,000 to 2,500 age one and older rainbow trout per mi, with 150 to 200 of these fish over 13 in. The rainbow trout population estimate for 2003 was 1788/mi which falls short of the number goal, but is within the size goal (161/mi). The 2005 estimate may, however, surpass both management goals for numbers and size of fish. Given the drought conditions that have prevailed over the past four years and with no apparent reduction in fishing pressure, it is remarkable the fish population has held up as well as it has in the Stillwater River.

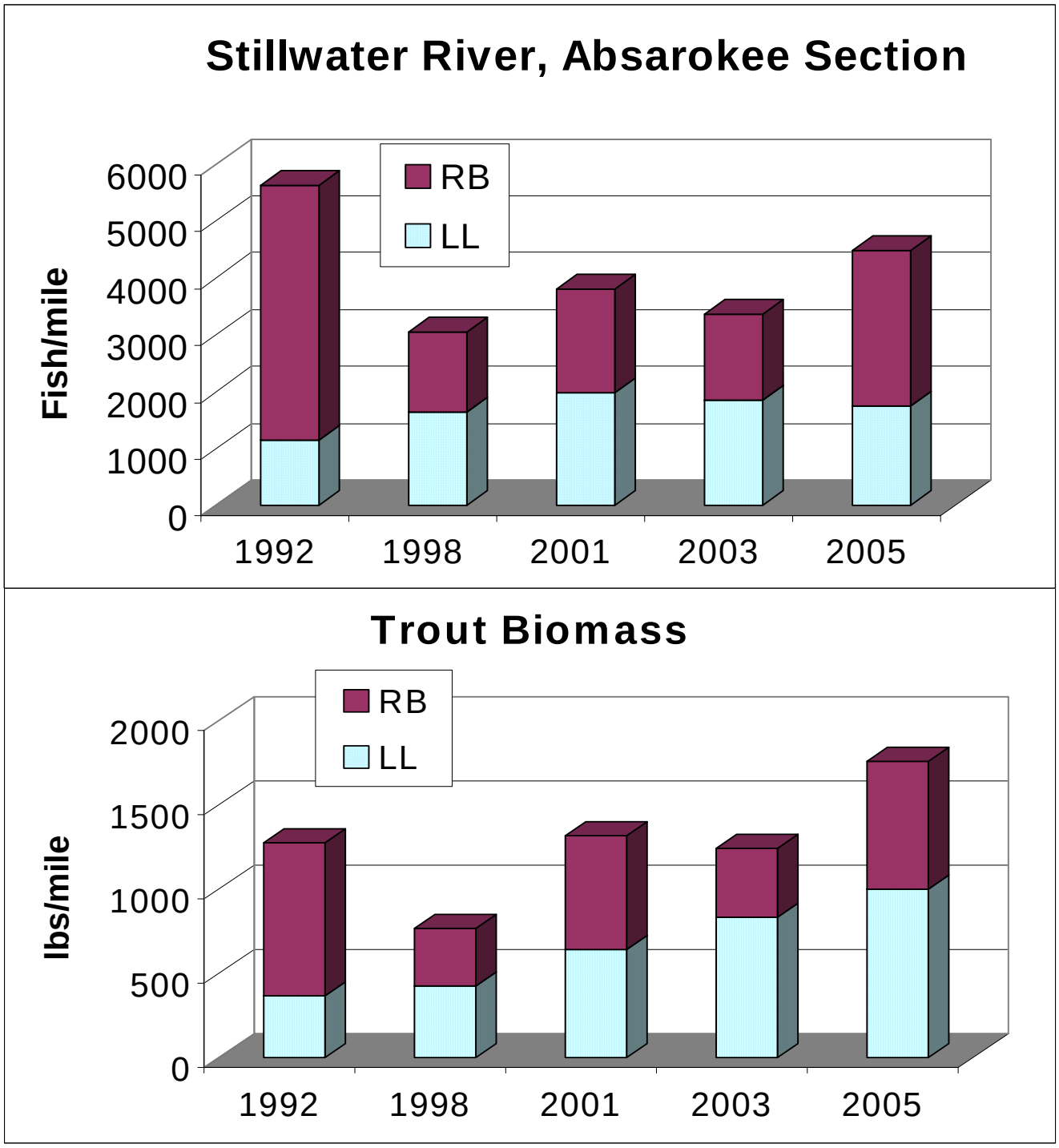

Figure 22. Trout numbers and biomass estimates from the Stillwater River, Absarokee Section for rainbow (RB) and brown (LL) trout.

Table 14. Population data from the Stillwater River, Absarokee Section collected during September 2003 and 2005. Age data were not available yet for the 2005 estimate.

Species	Age Class	Average Length (in)	Average Weight (lb)	#/mi*	Biomass (lb/mi)
2003					
Brown trout					
	1	4.0	0.03	78 (11)	2.3
	2	7.1	0.14	997 (140)	141.6
	3	9.5	0.31	329 (42)	102.6
	4	11.9	0.63	396 (39)	250.5
	5	14.4	1.13	112 (22)	125.8
	≥6	16.2	1.59	19 (8))	30.8
			Totals	**1,932** (153**)**	**653.6** (54.1)
Rainbow trout					
	1	3.4	0.03	75 (12)	1.9
	2	6.1	0.11	845 (134)	89.0
	3	9.7	0.36	462 (47)	166.5
	4	12.4	0.71	310 (40)	219.0
	≥5	13.9	0.93	86 (26)	80.2
			Totals	**1788** (151**)**	**556.5** (54.1)
2005					
Brown trout					
	3.0-4.4			107	33.6
	4.5-5.9			7	0.5
	6.0-7.4			219	28.9
	7.5-8.9			274	55.8
	9.0-10.4			269	93.2
	10.5-11.9			234	116.7
	12.0-13.4			189	146.3
	13.5-20.9			443	509.2
			Totals	**1742** (163**)**	**954.0**
Rainbow trout					
	3.0-4.4			49	1.1
	4.5-5.9			233	16.3
	6.0-7.4			1010	132.3
	7.5-8.9			390	85.2
	9.0-10.4			295	106.1
	10.5-11.9			254	130.5
	12.0-13.4			232	168.9
	13.5-20.9			139	138.9
			Totals	**2602** (206**)**	**779.1**

* Numbers in parentheses represent the standard deviation of the estimate.

West Rosebud Mackay Section

The Mackay Section of West Rosebud Creek is located near the Custer National Forest boundary where the stream leaves the steep Beartooth Mountains face. This 7,900-ft section extends from the Pine Grove Campground (N45.27567 W109.64538) downstream to the first set of cabins and bridge at the Mackay Ranch (N45.28834, W109.62402). Fishing pressure within this section, particularly on the upstream end near the USFS campground, is relatively heavy.

In September 2004, a fish population estimate was completed (Table 15) in the Mackay section. In 1986 and 1994, estimates were done in the fall when brown trout are predominant, so in 1998, the sampling time was changed to the spring. In 2004, the estimate was again done in the fall when other priorities precluded spring sampling. Brown, rainbow and brook trout, mountain whitefish and sculpin are present in the section in the fall, but brown trout is the predominant fish species. During marking, 196 fish were captured, 203 were captured during the recapture, and 25 of those were recaptures, yielding a population estimate of 2,576/mi (Table 15). This is the highest population estimate obtained at this site (Figure 23). The large number is likely inflated because more than half of the fish in the estimate were age 0. During the marking run, 50 age-0 fish were captured and 32 were captured during the recapture run with only 1 recapture. This low recapture rate makes the estimate unreliable. Excluding age-0 fish, the population estimate was very similar to that of 1998. Fish age 2 and 3 decreased in abundance from 1998 to 2003 by 26% and 50% respectively, while all other age classes differed by less than 20%.

Rainbow and brook trout are also present in the monitoring section, but too few rainbows are generally collected to obtain a reliable estimate. Nineteen rainbows were marked in 2004, 16 were captured, and only 1 was a recapture. Rainbows ranged in size from 1.9-15.4 in, and 15 of the 35 caught were age-0 fish. Only 3 brook trout were captured on the marking run, ranging in size from 2.9-6.1 in. Brook trout in this section were found only in side channels, beaver dams and backwater areas. Mountain whitefish are also present, but rare. The abundance of age-0 rainbow and brown trout suggests this is a spawning area. In the future, the Mackay Section will be monitored more frequently to study the potential effects of the Mystic Dam hydroelectric power production on the West Rosebud Creek fishery.

Table 15. Brown trout population estimate from the Mackay Section of West Rosebud Creek, 2004.

Age Class	Average Length (in)	Average Weight (lb)	#/mi*	Biomass (lb/mi)
0	3.0	0.02	1575 (211)	32.8
1	5.2	0.08	464 (88)	39.2
2	8.6	0.25	267 (48)	66.2
3	11.2	0.53	91 (16)	48.1
4	13.8	0.94	133 (17)	124.7
5	17.1	1.76	41 (10)	72.8
≥6	18.1	2.01	6 (3)	12.7
		Totals	**2576** (235**)**	396 (37.9)

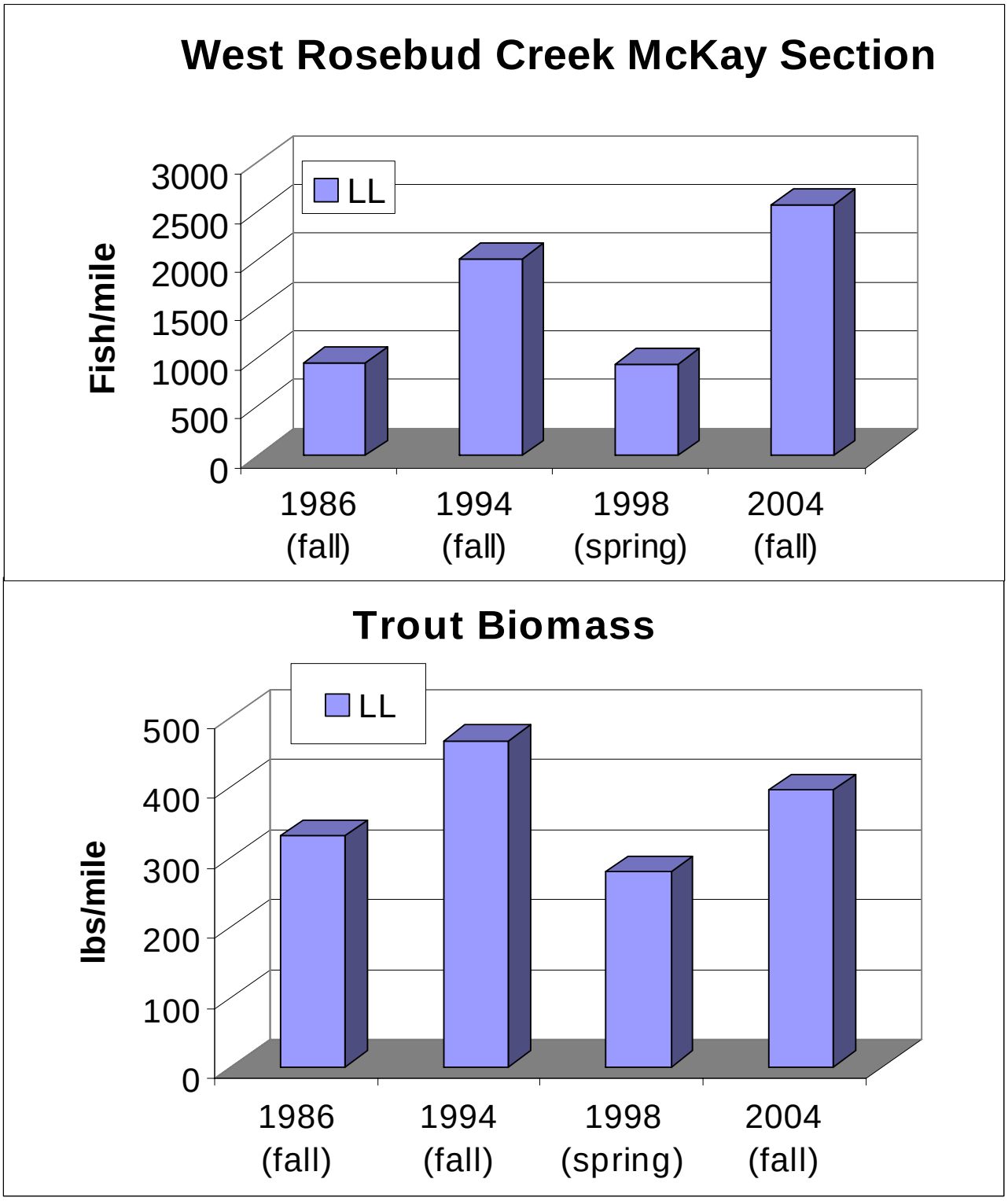

Figure 23. Brown trout (LL) population statistics from the Mackay Section on West Rosebud Creek.

West Rosebud Creek Mystic Lake Bypass

As part of Pacific Power & Lights' (PPL) relicensing of its Mystic Lake Hydropower Unit, studies were done to determine the status of the fisheries downstream of Mystic Lake and to evaluate the impacts of power production on the fishery. The bypass reach of West Rosebud Creek that extends from Mystic Dam to the powerhouse upstream of West Rosebud Lake, was electrofished. Water for power production is piped horizontally from Mystic Lake for approximately 2 miles, bypassing the creek, then dropped 1,100 feet vertically to the powerhouse, where the water rejoins the creek channel (GEI 2005a). At its maximum power-generation rate, the bypass pipe and powerhouse can pass between 120 and 160 cfs of water. The typical hydrograph of the bypass reach is 3-5 cfs from September 1 to May 31 and 10 cfs from May 1 to early July, when flows into Mystic Lake exceed maximum power production (120 cfs) and begin to spill over the dam. The bypass reach then returns to a relatively normal hydrograph with flows spilling over the dam and increasing and decreasing in accordance with snow melt and precipitation. Bypass flows typically peak at around 300 cfs in early July, as opposed to 500 cfs in mid June, if the hydropower project is not in operation (GEI 2005b). Naturally regulated flows continue through the summer until sometime in August when Mystic Lake inflows decrease below the maximum of 120 cfs. At this flow the dam no longer spills water, and a valve is opened in the pipeline immediately downstream of the dam to release approximately 10 cfs of water to the bypass reach of stream. On September 1, the flow is decreased to 3-5 cfs for the duration of the winter. The aim of this study was to determine if changes in the natural hydrograph in the bypass reach were affecting the fishery. Previous to this study, no sampling had occurred in the bypass reach.

In September 2004, 4 sites were electrofished, starting immediately upstream of the powerhouse and extending upstream to a location where the valve water enters the stream. Upstream of the powerhouse (N45.24306 W109.73242), there is a series of bedrock cascades which act as fish barriers, and a natural 200 foot waterfall immediately downstream of Mystic Dam where brown and rainbow trout are present. In the stream, 22 rainbows ranging in length from 1.3 to 8.1 in were captured. Fish less than 2 in were recently-emerged age-0 fish. Only one 9.3 in brown trout was captured, but two others were observed. Flows during electrofishing were relatively high, and efficiency was low. The presence of brown trout in this section of creek suggests that the lower reaches and the weir at the powerhouse are passable up to this point. West Rosebud Creek and West Rosebud Lake have abundant brown trout populations downstream of the powerhouse.

The second sampling location immediately upstream of the bedrock cascades (N45.23904 W109.73724), is composed of bedrock and large boulder substrate with plunge and pocket pools. Approximately 200 ft of stream were electrofished. Only rainbow trout (43) were captured, ranging in size from 1.3 to 8.2 in. Age-0 rainbow trout were also present. The lack of brown trout suggests the cascades downstream are barriers to fish passage.

At the 340-ft third site, a mark-recaptured population estimate was performed. This site is 300 yards upstream of the West Rosebud Trail crossing, at power pole #27 (N45.23591 W109.74664). Although it is a lower gradient than the other 3 sites, it is still considered high gradient. It is dominated by boulder and small-boulder substrate with high gradient riffles, runs, and a few pools. During the marking run on August 3, 2004, 127 fish were captured. Of the 178 fish recaptured on September 1, 2004, 60 were recaptures. The population estimate was on 1-in

size groups because no scales were taken and there were no clear distinctions between age-classes based on length frequency (Figure 24). The population estimate for this reach was 4,848 rainbow trout /mi (Table 16). Except for the smallest size class (0-2.9 in), there were sufficient recaptures to provide a reliable estimate for all size classes of fish. Although the average size fish (4.7 in and 0.07 lbs) was small in this reach of stream, the population appeared to be very healthy. Age-0 fish were captured in the section on the recapture run. Fish size in high elevation, low-productivity streams is often limited by cold water temperatures and limited food. The relative weight of a fish (an index of weight relative to length, where 100 is average and values < than 100 indicate a fish weighs less than average for its length, and a fish > 100 weighs more than average) suggests the condition of the rainbows was above average in the creek. Despite their small size, the fish were in good condition, suggesting temperature may limit fish growth more than food availability. All fish captured were adipose-fin clipped to determine survival across years.

Size Class	#/mi	Biomass (lb/mi)	Relative Weight (lb)
0.0-2.9	788	7.9	178
3.0-3.9	1955	39.6	124
4.0-4.9	930	32.0	109
5.0-5.9	421	29.4	108
6.0-6.9	395	42.2	100
7.0-7.9	195	32.6	101
8.8-8.9	164	36.0	104
Totals	**4848** (400**)**	220.0 (21.7)	

Table 16. Fish population statistic from the bypass reach of West Rosebud Creek, Site 3, during 2004.

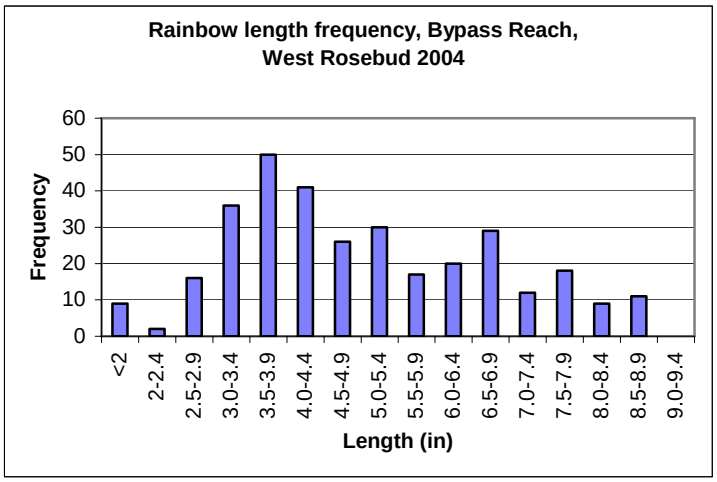

Figure 24. Length frequency of rainbow trout from the Bypass Reach of West Rosebud Creek, Site 3, during 2004.

The fourth section was approximately 0.5 miles upstream of site 3 (N45.23145 W109.75158). This reach is dominated by large boulder substrate and plunge pools. In this 300 foot stream, 86 rainbow trout were captured, ranging in size from 2.6-8.7 in. Because of high flows and the complexity of habitat, capture efficiency was low (< 50%). In all reaches sampled in the bypass portion, the fishery appeared to be in excellent condition despite high gradient, very large substrate and low winter flows, and there appeared to be suitable habitat for spawning, rearing and over-wintering. The fisheries data collected during 2004 indicated that current alterations in the hydrograph of West Rosebud Creek in the bypass reach did not cause substantial negative effects on the fish population.

West Rosebud Creek Spawning Counts

One of the effects of power production on West Rosebud Creek is the augmentation of late season flows downstream of the powerhouse (GEI 2004a). As inflows to Mystic Lake continue to decline through the winter, however, and the lake reaches low pool elevation, flows

downstream of the powerhouse drop. This reduction in flows generally occurs in February. One of the concerns FWP had with the changes in the hydrograph is that fall-spawning brown trout depositing eggs in areas available under augmented fall water conditions would be exposed to desiccation or freezing when flows decline in February. The survey began to establish baseline spawning information. A redd survey was conducted on October 27, 2004 beginning at the downstream county bridge on the Mackay Ranch (second bridge on county road from Fishtail) and continuing to the Pine Grove Campground (approximately 5 miles). Redd locations are given in Table 17. Although brown trout redds were found throughout the reach where suitable spawning habitat was available, the highest concentration of redds were within the Mackay electrofishing section and areas immediately upstream and downstream. Approximately 0.5 mi downstream of the Mackay Section is a high gradient reach of stream which was not surveyed. Downstream of that section, the stream has a moderate gradient with few side channels and mostly cobble substrate. The habitat in the Mackay Section contains more side channels, a lower gradient, and more gravel suitable for spawning.

Table 17. Brown trout redds in West Rosebud Creek on the Mackay Ranch and Custer National Forest during 2004.

Latitude	Longitude	# of redds	Latitude	Longitude	# of redds
N 45 20.518	W 109 36.040	4	N 45 17.464	W 109 37.168	1
N 45 20.504	W 109 36.080	1	N 45 17.376	W 109 37.376	1
N 45 20.475	W109 36.105	1	N 45 17.233	W 109 37.435	1
N 45 20.402	W 109 36.194	1	N 45 17.116	W 109 37.469	3
N 45 19.903	W 109 36.202	2	N 45 17.079	W 109 37.467	1
N 45 19.688	W109 36.112	1	N 45 17.025	W 109 37.553	2
N 45 19.225	W 109 36.275	3	N 45 17.014	W 109 37.560	1
N 45 19.031	W 109 36.340	1	N 45 16.929	W 109 37.753	1
N 45 18.309	W 109 36.850	1	N 45 16.927	W 109 37.844	1
N 45 17.668	W 109 37.060	1	N 45 16.880	W 109 38.028	1
N 45 17.560	W 109 37.142	2			

Bad Canyon Creek

The rehabilitation of the upper 3 miles of Bad Canyon Creek was completed in 2002. In addition to the 21 cutthroats saved from the creek prior to chemical treatment, LeHardy Rapids YCT were stocked in 2003 and 2004. In the spring of 2003 and 2004, the 21 rescued fish successfully spawned. In 2005, extensive electrofishing surveys were performed across the entire drainage to determine the survival of stocked fish and the recovery of brown trout inadvertently poisoned in areas downstream of the barrier. Eight locations were electrofished from the mouth to near the headwaters.

The first site sampled, at the Stillwater County Road Crossing on the Flying C Ranch, is approximately 100 yards upstream from the confluence with the Stillwater River. In late summer and through the winter, the creek is normally dry in this area, but a wet spring in 2005 led to surface flows which reached the Stillwater River into July. It was electrofished to determine potential fish movement from the Stillwater River into Bad Canyon Creek. Rainbow and brown trout are present in the Stillwater River, and when flows reach the mouth, rainbow trout could potentially migrate upstream into Bad Canyon Creek and hybridize with cutthroat in areas

downstream of the barrier. A 300-ft section was electrofished starting at the county road crossing and extending upstream; only one 6-in brown trout was found. These limited data suggest fish do not quickly colonize the intermittent reaches of Bad Canyon Creek, even though opportunities for colonization do exist during certain times of year.

Two other sections downstream of the barrier were sampled, beginning at the first road crossing and extending upstream to Ekwortzel Draw (N45.50469 W109.77610). The first road crossing (N45.52592 W109.81656) was the approximate downstream extent of the fish kill during the chemical treatment in 2002. A 430-ft section was surveyed in this reach, and the brown trout population appeared to be in good shape, with numbers and size range similar to those before treatment (Table 18). A few cutthroats were also present at this site, but the population was dominated by browns. Most of the cutthroat in this reach of stream were stocked near Ekwortzel Draw. In 2005, the fish population was mostly cutthroat trout, but brown trout have also successfully recolonized this reach of stream (Table 18). The combined brown and cutthroat trout population has not returned to pre-treatment numbers, but the cutthroat stocked at Ekwortzel Draw appear to be in good condition.

Five sections of Bad Canyon Creek were electrofished upstream of the barrier: the first, a 250-ft single electrofishing pass where no population estimate was made, occurred approximately 100 yards upstream of the barrier (N45.51187 W109.80908); the second, approximately 0.5 miles upstream of the barrier falls (N45.51328 W109.81927), was 360 ft; the third was 380 ft and began at the confluence of Trail Draw (N45.56667 W109.81667); and the fourth and fifth sections were 330 and 360 ft and were located approximately 0.5 miles upstream of Trail Draw (N45.51372 W109.83686) and upstream of Tepee Creek (N45.50903 W109.84311). Only cutthroat were captured upstream of the barrier falls and the population estimates ranged from 308-531/mi. No cutthroats were found upstream of Tepee Creek. The release sites of fish stocked into Bad Canyon Creek upstream of the barrier were at Tepee Creek, Smith Coulee, and near Boundary Draw. The fish appeared to have distributed themselves throughout the upper 3 miles of the creek, with the exception of upstream of Teepee Creek. Brown trout occupied this reach of stream before treatment, so it is unclear why the cutthroats have not yet moved into the habitat. A possible explanation is that cutthroat densities are still relatively low compared to the densities of brown trout before treatment. As reproduction of stocked fish begins in 2006, the density of cutthroats should increase to the level where fish may seek out unoccupied habitats, such as those upstream of Teepee Creek. The 21 fish that were held in Trail Draw during treatment and released, successfully spawned during the spring of 2003 and 2004. Age-0 fish were noted during subsequent electrofishing in 2003 between Smith Coulee and Trail Draw, and at Smith Coulee where fish were stocked in 2004.

Erosion and undermining of the barrier on the south bank occurred during the chemical treatment of Bad Canyon Creek. A temporary patch was put in place to prevent further erosion, but a more permanent solution was needed to prevent the barrier falls from failing. During 2005, funding was obtained through the Future Fisheries Program, from Custer National Forest, and, in cooperation with the Bureau of Land Management (BLM), repairs were made to the falls. Materials for the project were flown in by helicopter and transported up and down the canyon by hand. Material on the south bank was removed and replaced with alternating layers of rock and concrete ending with a rubble cap. In this same area, but downstream of the barrier, eroded material was fortified by alternating rock layers, concrete and woven wire to build a vertical wall. The hope is that this wall will allow the unconsolidated materials upstream to settle without

failing. Between 15 and 20 feet of hand-placed riprap was placed on the northern creek bank, upstream of the barrier. This area experienced erosion in 2005 during spring runoff. The riprap was placed to prevent further erosion and the possibility of the creek moving north around the barrier falls. Rubble and cobble was removed from the pool tailout immediately downstream of the barrier, which lowered the water level in the pool.

Table 18. Fish population estimates and average lengths of fish from Bad Canyon Creek during June 2005.

	Yellowstone cutthroat trout			Brown trout		
Site	#/mi	95 %CI	Length (in)*	#/mi	95 %CI	Length (in)*
County Road				--	--	6.2
Lower Rd Crossing	124	(122-126)	4.9 (3.6-11.10)	1089	1057-1121	6.3 (1.3-13.2)
Ekwortzel Draw	532	472-593	4.9 (3.2-11.4)	223	219-226	9.0 (7.4-11.9)
Upstream of Barrier	--		5.6 (2.6-9.0)			
0.5 Mi US Barrier	484	410-558				
Trail Draw	308	295-320	6.2 (2.1-9.8)			
0.5 Mi US Trail Dr	531	450-612	5.6 (4.3-9.3)			
US Tepee Cr	--					

* Numbers in parenthesis represent the length range of fish captured

Goose Creek

Goose Creek is located at the headwaters of the Stillwater River, north of Cooke City. There are five major lakes with fish in the drainage—Little Goose, Goose, Huckleberry, Mutt and Jeff lakes. Goose and Little Goose lakes have self-sustaining populations of YCT, and Huckleberry, Mutt and Jeff lakes have self-sustaining populations of stunted brook trout. Goose Lake has recently become FWP's brood source of wild YCT, and will likely replace the old McBride Lake brood stock. Goose Creek flows approximately 5 miles from Goose Lake until it reaches the Stillwater River. After leaving Goose Lake, the stream is high gradient for approximately 1.5 miles through a large meadow. The outlet stream of Huckleberry Lake runs through the small and shallow Mutt and Jeff lakes before entering Goose Creek in this meadow. Surveys conducted during the summers of 2003 and 2005 were used to determine the status of the fishery in Goose Creek and identify potential fish migration barriers precluding brook trout colonization of Goose Lake.

In August 2003, electrofishing in Goose Creek, from its confluence with the outlet of Jeff Lake upstream to Goose Lake, revealed the dominance of brook trout in the meadow reach (Table 19). A small 3-ft rubble and bedrock falls, located approximately 1 mile downstream from Goose Lake (Figure 25), was identified as the barrier to brook trout colonization. Brook trout density slowly decreased as cutthroat density increased, up to the barrier. No brook trout were captured approximately 300 ft upstream of the barrier (Table 19). Although habitat conditions in the meadow are ideal, we found no evidence of natural reproduction by cutthroats. It is likely that predation and competition from brook trout severely limit the cutthroat fishery in this reach.

Because of the low height and unstable material of the barrier falls, that prevents brook trout from colonizing Goose Lake, an investigation was begun in 2005 to determine what other natural barrier falls were present in the system downstream from the outlet of the Mutt Lake confluence with Goose Creek. In July 2005, two bedrock barrier falls were identified. Downstream of the first meadow the creek is high gradient and eventually leads to a large 20 ft bedrock waterfall (N45.09266 W109.95134) (Figure 26). Downstream of this falls, the creek enters another meadow section with excellent fish habitat. Two more bedrock falls are present in Goose Creek, downstream of the second meadow and before the confluence with the Stillwater River. A small tributary enters Goose Creek in the second meadow. This creek was electrofished up to a high gradient area (N45.09031 W109.95483), and only brook trout were captured (Table 19). Only 200 ft of stream were surveyed, and no fish were captured immediately upstream of the high gradient reach.

Table 19. Fish captured from Goose Creek during August 2003 and July 2005.

	Yellowstone cutthroat		Brook trout	
Site	#	Length (in)*	#	Length (in)*
Jeff Meadow	2	7.9 (6.6-9.1)	57	5.7 (2.1-9.4)
Upstream of Jeff Meadow	11	9.2 (7.8-11.2)	36	6.9 (3.6-9.2)
Downstream of Barrier	8	7.6 (4.4-10.6)	5	8.3 (7.1-9.6)
Upstream of Barrier	12	6.9 (4.6-11.4)		
Unnamed south tributary	0		12	3.8-10.0

* Numbers in parentheses represent the length range of fish captured.

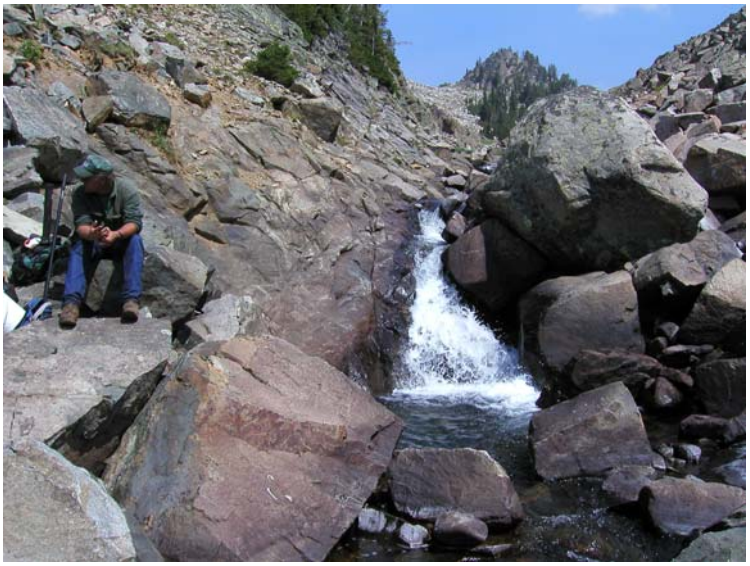

Figure 25. Barrier falls in Goose Creek preventing brook trout from colonizing Goose Lake.

Figure 26. Barrier falls in Goose Creek between the first and second meadows downstream of Jeff Lake.

Fishtail Creek

Fishtail Creek is a tributary to West Rosebud Creek that drains the Beartooth Mountains between the Stillwater and Fishtail plateaus. After leaving the mountains, the stream flows approximately 14 miles through a wide valley until it reaches the West Rosebud near Fishtail. A fish population estimate was performed on April 19, 2004 beginning at the Highway 419 bridge crossing and extending upstream 590 ft (N45.43890 W109.55148). The fish population in this section was almost exclusively brown trout (Table 20), except for 2 rainbow trout and 1 white sucker that were captured. All age classes of brown trout were well represented in this reach of stream, and the population appeared to be very healthy.

Table 20. Fish population statistics from Fishtail Creek collected on 4/19/04.

Species	n*	#/mi	95% CI	Average length (in)**	Average weight (lb)**
Brown trout	98	1266	779-1754	6.8 (3.1-12.5)	0.16 (0.01-0.65)
Rainbow trout	2	-		7.6 (6.0-9.5)	0.18 (0.10-0.26)
White sucker	1	-		2.0	0.01
Total	**101**	**1266**			

* n signifies the number of fish captured
** Numbers in parenthesis are the length and weight range of fish captured

Morse Creek

Morse Creek, a tributary to East Rosebud Creek, drains a portion of the Beartooth Face between East and West Rosebud creeks. The creek was inventoried on May 3, 2004, from near the Forest Service boundary to the downstream end of the Lazy EL (Mackay) ranch to document the current fishery and determine the potential for restoring it with a cutthroat trout population. Beavers, particularly upstream of the Mackay Ranch buildings, heavily influence the stream habitats. Approximately 100 yards upstream of the buildings, there is a small instream impoundment on the creek with a 3 ft concrete spillway. This structure may be a barrier to fish passage. From this pond upstream, a long series of beaver ponds extends approximately 1 mile. There may be areas of natural stream in this reach—it was only observed from a distance—but most of the channel is composed of beaver impoundments. Approximately 1 mile upstream of the ranch building is a section of free- flowing stream with less beaver influence that extends about 0.5 miles before it enters a second beaver complex. The stream, downstream of the Mackay ranch buildings, flows through their corrals and parallels the ranch road with nearly double the water (3-5 cfs) of areas farther upstream. Beavers are also found in this section, but to a lesser degree than upstream of the buildings. The creek flows about 2 miles before entering a large beaver dam complex, and two ditches from East Rosebud Creek cross over Morse Creek in flumes in this reach.

Two sections of the creek were electrofished upstream of the ranch buildings and the second beaver dam complex (N45.31111 W109.56892). Only longnose dace (16) were captured in 300 feet of stream where flows were approximately 1 cfs. Better habitat exists in the beaver ponds, but these could not be sampled because of their depth. A second section was electrofished between the first and second beaver dam complexes, upstream of the ranch buildings

(N45.31391 W109.56405). Only longnose dace were captured in this reach too. The man-made pond immediately upstream of the buildings was visually inspected for fish, but none were observed. The presence of longnose dace in this upstream area suggests flows are sufficient to sustain fish; however, the abundant beaver dams have disturbed the connectivity between reaches, limiting fish potential. It was unclear if salmonids were absent upstream of the ranch buildings, as the beaver ponds were not adequately sampled. If salmonids are present, however, they are likely rare, because spawning and rearing occur in portions of the stream without ponds, and no salmonids were found in these areas during this survey.

A third section was surveyed approximately 200 yards upstream of the ranch access road culvert (N45.32161 W109.53690), and 1 brown trout, 14 brook trout, and 2 white suckers, in addition to 8 longnose dace, were captured. Greater stream flows and a stream channel without ponds provide better habitats for all life stages of trout, possibly explaining their presence in this reach of stream. It is also possible, however, that the concrete spillway in Morse Creek prevents passage and colonization of trout upstream of the ranch buildings. YCT restoration downstream of the ranch buildings is possible, but would be difficult due to lack of a suitable barrier location, the irrigation flumes, and the abundance of beaver activity. Such a project would be possible with the cooperation of the ranch owners. Upstream of the buildings there may be suitable habitat for cutthroat trout, but the presence/absence of other salmonids would need to be confirmed. Lack of connectivity between reaches of stream and low flows may limit cutthroat potential in this reach.

Clarks Fork of the Yellowstone River

Rock Creek, Fox Section.

The 4,800-ft-long Fox Section of Rock Creek is located approximately 7 miles downstream from Red Lodge. Rock Creek, from Red Lodge downstream 20 miles to the confluence of Red Lodge Creek, often has major water shortages during late summer and early fall, the peak of the irrigation season. In addition, fish populations in Rock Creek are often impacted by high flows, which cause extensive erosion and movement of bedload (Poore 1997). Major flooding in June 1992 shifted huge amounts of bedload through the Fox Section, and hit fish populations particularly hard during 1993.

In March 2005, fish populations in the Fox Section of Rock Creek were sampled. Scale samples collected from trout have not yet been analyzed, so the estimate was based on size groups. During marking, 360 brown trout were captured, 382 were caught during recapture, and 181 of those were recaptures. This sequence yielded a total brown trout population estimate of 1,280/mi (Table 21). Seventy-eight rainbow trout were captured and marked, 80 were captured on the recapture run, and 26 of those were recaptures. The rainbow trout population estimate for 2005 was 499/mi. Total trout numbers have steadily increased in this section over the past 12 years (Figure 27). The combined brown and rainbow trout estimates for the Fox Section during 2005 were the most observed in the 20-year history of the site, even though the estimates for the smallest size class of both species is likely inflated by the lack of recaptures. In the past 6 years, the rainbow trout population has tripled, and the brown trout population has nearly doubled in the past 10 years. It is unclear why the population of fish in this section has continued to grow. It is possible that the habitat conditions have improved dramatically due to channel changes and subsequent flooding and erosion. Or it may be that drought conditions in this reach of stream

have proved beneficial to the fishery, particularly the rainbow fishery (Olsen 2003). This reach of Rock Creek is not substantially dewatered during the summer, and because of its altitude and proximity to the mountains, warm stream temperatures are not a factor. In fact, the warmer water conditions at this particular site may be beneficial to the fishery.

Table 21. Fish population data collected at the Fox Section of Rock Creek, March 2005.

Species	Size Class	Average Length (in)	Average Weight (lb)	#/mi	Biomass (lb/mi)
Brown trout					
	3.0-4.4			437	10.6
	4.5-5.9			86	4.0
	6.0-7.4			162	17.7
	7.5-8.9			83	14.8
	9.0-10.4			92	32.5
	10.5-11.9			177	86.4
	12.0-13.4			159	108.5
	13.5-14.9			68	61.5
	15.0-16.4			16	19.2
			Totals	**1280** (76)*****	**355.0**
Rainbow trout					
	3.0-4.4			225	3.5
	4.5-5.9			75	4.2
	6.0-7.4			71	8.1
	7.5-8.9			32	7.3
	9.0-10.4			31	10.8
	10.5-11.9			43	22.7
	12.0-13.4			19	15.4
	13.5-20.9			2	2.4
			Totals	**499** (54)*****	**74.6**

* Numbers in parentheses represent the standard deviation of the estimate.

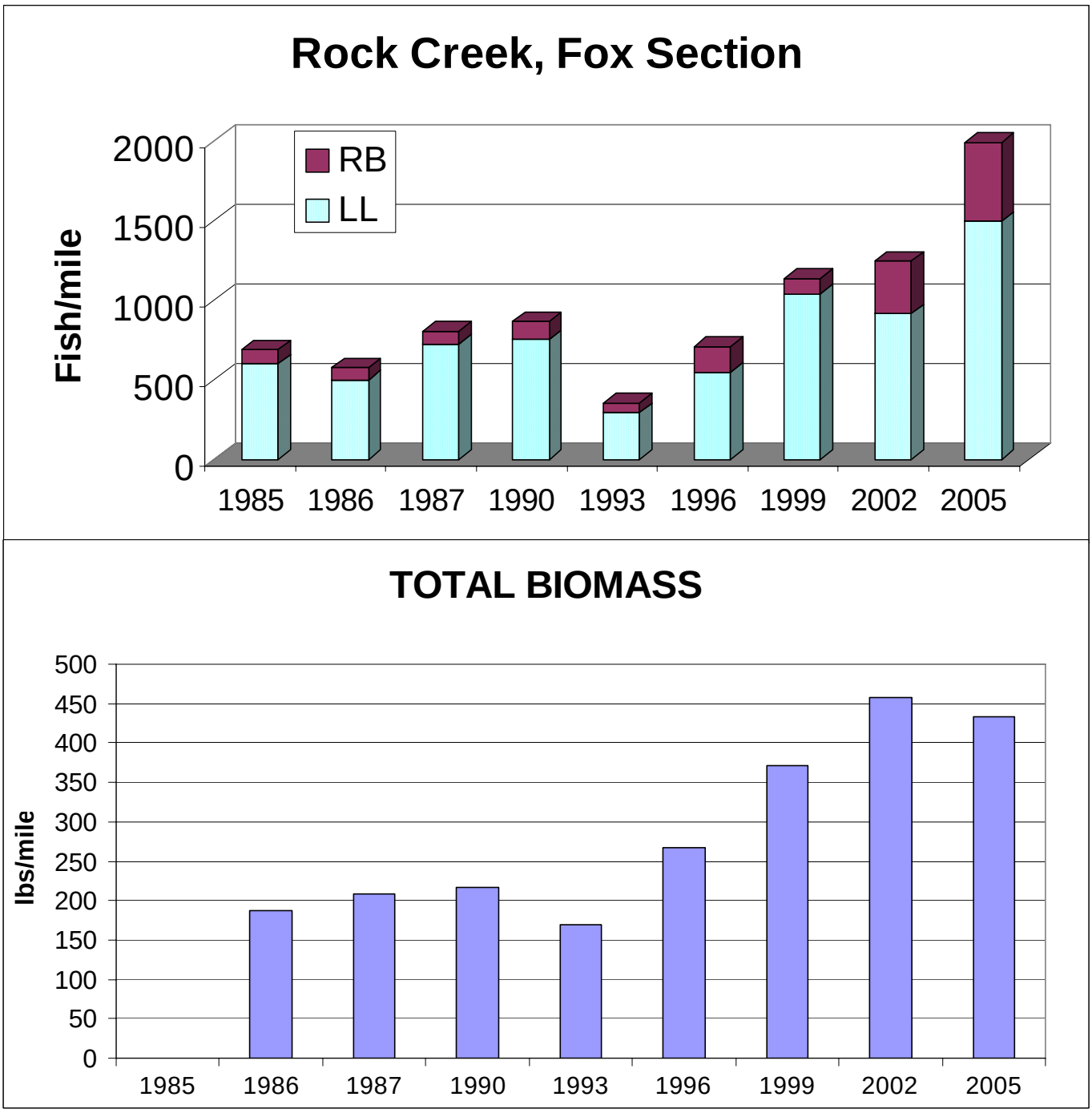

Figure 27. Rainbow (RB) and brown (LL) trout populations, and combined brown and rainbow trout biomass estimates, for the Fox Section of Rock Creek.

Clear Creek

Clear Creek is a tributary to Rock Creek that originates east of Red Lodge. The stream parallels Rock Creek for approximately 13 miles before their confluence near Roberts. Clear Creek is mostly spring fed, but flows are also augmented through irrigation water diverted from Rock Creek during summer. For most of the summer, Clear Creek is a major tributary to Rock Creek, which can be substantially dewatered in the vicinity of Roberts and areas downstream. The creek consistently flows between 5 and 20 cfs during the summer. In the past, fish passage

was limited because of a perched box culvert approximately 200 yards upstream from the mouth of the creek (Figure 28). A fish passage investigation initiated in May 2003 captured 20 brown and 3 rainbow trout upstream of the culvert. Their adipose fins were clipped, and they were released downstream from the culvert. A week later, the reach upstream of the culvert was electrofished again, and 8 of 23 clipped trout were captured. Only 1 fish was captured downstream of the culvert, but electrofishing was difficult in this section due to deep water. All the fish that successfully negotiated the culvert were greater than 11 in, except one rainbow that was 7.9 in. Depths and velocity measurements were made near and within the culvert. Height of the culvert outlet above the surface of the water below was 2.7 feet; the maximum velocity of the culvert was near 6 ft/s; and the average depth of the water in the culvert was 0.4 feet. Despite a large drop and fast velocities, the culvert was passable to larger fish at moderate flows, but not to juvenile fish, and most likely not to native fish such as whitefish, suckers and sculpin. Because of its constant flows through the summer and the potential spawning areas available upstream, a project was initiated to facilitate fish passage.

Funding to design and construct a fish passage at the culvert was obtained through the US Fish and Wildlife Service, Carbon County, and FWP's Future Fisheries Program. Confluence Consulting was contracted to design and build a structure that would allow juvenile and adult trout, and other native fish species, to pass. The design called for construction of a series of 5 step pools over a distance of approximately 120 feet. Each step, made of large boulders with a constructed jump pool between each step, raised the stream bed elevation approximately one foot. These steps increased the creek bed elevation approximately 5 inches above the outlet of the culvert, eliminated the 2.7 inch drop, and reduced the velocities in the culvert. Construction began in September 2005 and lasted 5 days, including site rehabilitation (Figure 28), at a total cost of just over $38,000. Immediately following construction, fish were observed negotiating the step pools into the culvert. The cooperation of the local landowner was key to the project's success.

Figure 28. Clear Creek fish passage project located at the county road culvert: pre-project (left) and post project (right).

Red Lodge Creek

Red Lodge Creek downstream of Cooney Reservoir was sampled in 2003 and 2004. This fishery is a mix of wild fish from Red Lodge Creek and fish flushed through the dam outlet. In April 2003, the stream from the county road culvert upstream to the weir (approximately 500 ft) was sampled in conjunction with dam inspection and a temporary shut down in flows. At this time, 8 white suckers, 3 longnose suckers, 3 mountain suckers, 3 longnose dace, 2 lake chubs, 1 rainbow trout and 1 walleye were captured. In October 2004 the Joliet High School students helped sample the creek a second time. One white sucker, 5 longnose dace, 64 mountain whitefish, 16 brown trout, 6 rainbow trout and 1 pumpkinseed were captured.

Red Lodge Creek experienced significant flooding during the spring of 2005. The flow of 3,700 cfs recorded at the USGS gauging station on May 12, was the greatest in its 69-year history. Willow Creek's peak flow on this date was 2,100 cfs, so the total amount of water entering Cooney Reservoir was 5,800 cfs. The resultant flooding caused extensive bank erosion and loss of bridges and culverts both up- and downstream of Cooney Reservoir. Many fish escaped into Red Lodge Creek downstream. Over 1,000 recently stocked rainbow trout were captured in the pool immediately below the spillway. One angler reported catching a walleye near Rockvale in Rock Creek. Red Lodge Creek was sampled again in the fall of 2005 from the county road crossing to the upstream weir. In addition to many whitefish and suckers, 3 rainbow trout, 9 brown trout and 13 walleyes up to 24 in were captured in this 300-ft reach of stream. One 8.4-in burbot was also captured.

West Red Lodge Creek. An irrigation diversion structure of large granite boulders, located in West Red Lodge Creek immediately upstream of Highway 78, elevates the stream approximately 3 ft. Local landowners have complained that this diversion structure was impeding fish passage and leading to reduced fish numbers. Beginning on July 22, 2004, in 520 ft of stream immediately upstream of the diversion, 55 brown trout, ranging in size from 2.2-13.2 in, were captured, adipose fin clipped and released downstream of the diversion. Ten days later 119 brown trout were captured in the same 520 ft of stream; 27 were fish that had successfully passed upstream of the irrigation diversion. An additional 400 ft downstream of the diversion was surveyed, and 98 fish were captured. Seven of these were fish that did not swim upstream past the diversion. The size range of fish that successfully negotiated the irrigation diversion was 5.5-13.0 in, and the size range of fish that did not pass over the dam was 7.7-10.3 in. Over half of the fish that were moved downstream of the diversion were able to pass over the structure in only 10 days. All size classes, except for the smallest (likely age-0) fish, were able to pass over the dam. Too few age-0 fish (5) were clipped initially, compared to the number captured 10 days later (30), to adequately determine if this age class could negotiate the diversion. Capture was less efficient than recapture due to higher, more turbid water conditions during the initial survey. Flows in this reach of West Red Lodge Creek are augmented by irrigation water from East Rosebud Creek. The mark-recapture population estimate for this site, excluding the age-0 size class (2.0-3.5 in), was 1,800/mi (Table 22). The average size of brown trout in the section was 8.4 in and 0.30 lb. In addition, mottled sculpin, mountain whitefish and longnose sucker were present in the stream.

Table 22. Fish population statistics from West Red Lodge Creek at the Highway 78 bridge crossing, July 2004.

Species	Size Class	#/mi	Biomass (lb/mi)
Brown trout			
	4.5-5.9	816	56.6
	6.0-7.4	207	22.3
	7.5-8.9	286	61.4
	9.0-10.4	295	103.7
	10.5-11.9	136	70.3
	12.0-13.4	60	44.0
	Total	**1,800** (434)*	**355.1**

*The number in parenthesis is the standard deviation of the population estimate

Thiel and Harney creeks. Thiel and Harney creeks are tributaries to East Red Lodge Creek that drain off the northern face of the Beartooth Mountains between Roscoe and Red Lodge. Both streams are small (between 2 and 5 cfs) and were last sampled in 1994 near the Beartooth Face on Forest Service and State land (Poore 1997). The streams were sampled again in 2004 near the intersection of Highway 78. Five hundred feet of Thiel Creek was electrofished starting at the highway culvert, and 63 brook trout were captured ranging in size from 4.0-11.6 in (average 7.0 in). All brook trout captured were in excellent condition. Mottled sculpin were also abundant in the stream. The size of sculpins in Thiel Creek was unusually large. Of the 21 captured and measured, several were larger than 5 in. Brook trout are present in Thiel Creek upstream to near its headwaters, on State land along the Beartooth Face (Poore 1997).

Harney Creek was surveyed for 300 ft beginning at the Highway 78 culvert. Brook trout and mottled sculpin were the only fish captured. The 23 brook trout captured ranged in size from 3.1-10.1 in (average 5.9 in). Ten sculpin were also captured from 1.8-5.2 in. Harney Creek was last surveyed during the summer months on the CNF and found to be fishless (Poore 1997). Harney Creek is dewatered, due to irrigation, more than Thiel Creek, and this may have been the reason it had fewer fish. Given the threats to the cutthroat population in the Brushy Fork of Willow Creek and the difficulty of eliminating brook trout from that system, efforts are underway to find suitable habitat along the Beartooth Face where the cutthroats could be transplanted. Of these two streams, Thiel Creek appears to be more suitable for cutthroat restoration than Harney Creek.

Willow Creek

Three sections of Willow Creek were electrofished in April 2004 to determine the current species composition and size of fish. The first 540 ft section began at the bridge crossing, approximately 7.5 mi upstream of Cooney Reservoir (T5S R20E Sec4, N45.33440 W109.26200). Twenty-two brown trout were captured, ranging in size from 7.3-16.2 in (average - 10.6 in). Mountain whitefish, longnose sucker, mountain sucker and longnose dace were also captured. The second section of 150 ft began at the last county road crossing going south before reaching Highway 78 (N45.26497 W109.27442). In this section 16 brown trout, ranging in size

from 4.0-11.8 in (average - 7.9 in) were captured, but no other fish species. Dense willow growth made electrofishing difficult. The third 100 ft sampling occurred in the eastern-most fork of Willow Creek at the intersection of Highway 78 (N45.22224 W109.28682), where 2 brown trout and 1 brook trout were captured. Prior data collected from Willow Creek near the CNF suggests the stream contains only brook trout (Poore 1997). When combined with the data we collected, it appears that the transition between brook and brown trout dominance likely occurs around the Highway 78 crossings.

Brushy Fork of Willow Creek. Brushy Fork is the western-most fork of Willow Creek and is not labeled on most maps. The creek contains the only pure YCT population in the Willow Creek drainage, but the population is sympatric with brook trout (Poore 1997). In 2004, a project to suppress brook trout and allow YCT numbers to increase in the creek was begun by Pat Byorth, the YCT Biologist. The initial scoping process determined the difficulty of complete eradication of brook trout in the system, due to complex land ownership in the drainage (mostly residential subdivisions) and abundant beaver dams. A decision was made to attempt to suppress brook trout and allow cutthroat numbers to increase for transplant to another fishless stream, most likely along the Beartooth Face.

The confluence of the Brushy Fork and Willow Creek is approximately 0.5 mile upstream from the second site sampled on Willow Creek in 2004. Approximately one-quarter mile upstream of the confluence is a series of beaver dams that extend upstream for a mile. In April 2004, sampling in 500 ft of stream downstream of these beaver dams yielded only brown trout (22, size range 6.0-15.1 in) and mountain suckers. This result suggests the beaver dams are acting as a barrier to brown trout colonization in the upper reaches of the creek, where the cutthroat and brook trout reside. Upstream of the beaver dam complex is approximately a quarter mile of free-flowing stream and a large culvert at the Palisades Subdivision (N45.22437 W109.29711). The east and west branches of Brushy Fork meet immediately upstream of this culvert. Both forks are void of beaver dams for approximately half a mile before going under Highway 78. Upstream of the highway, beaver dams are more common, interspersed with sections of naturally flowing stream.

In 2004, the stream was electrofished, and brook trout were selectively removed in an effort to suppress them. Because the beaver dams are abundant and difficult to sample, the stream is small, and the brush dense, removal efforts were difficult (Table 23). The numbers of cutthroat in the table may be somewhat misleading because, unlike brook trout, cutthroat were released and some were likely captured on subsequent removals. Removal data collected over two years indicate that in order to maximize brook trout removal efficiency, electrofishing should occur in May, before the cutthroat spawn, and in September, before the brook trout spawn. Fall sampling in particular is optimum for removing brook trout. During the fall, many adult fish in the beaver ponds move into the stream to spawn and are more vulnerable to electrofishing. In September 2005, almost as many brook trout were removed in 1 day (301) as in the previous 7 days (358). Many of these fish were > 12 in, while prior to this date, no fish > 12 in were captured.

Table 23. Summary of brook trout removed and other trout sampled in the Brushy Fork of Willow Creek during 2004 and 2005.

Location	Sub-reach	Date	Brook	Cutthroat	Rainbow
West Branch	200' DS Kawasaki Dealership to Hwy 78	4/6/04	7	11	
Main Creek	Beaver dams to Palisades culvert	4/23/04	14	10	
Main Creek	Beaver dams to Palisades culvert	11/9/04	46	44	
West Branch	Palisades to Hwy. 78	11/9/04	51	2	
West Branch	US Hwy. 78	5/10/05	157	28	
Main Creek	Beaver dams to Palisades culvert	6/16/05	33	12	1
Main Creek	Beaver dams to Palisades culvert	6/20/05	9	6	
East Branch	Palisades to Hwy 78	6/20/05	41	6	
Main Creek	Beaver dams to Palisades culvert	9/26/05	95	22	
West Branch	Palisades to Hwy. 78	9/26/05	206	11	
		Totals	**659**	**146**	**1**

Flooding in May 2005 may have introduced rainbow trout into the Brushy Fork of Willow Creek. Unfortunately, prior to the flooding, spring conditions were unusually dry and water users had begun to irrigate. The wastewater from one of the ditches in the West Fork of Rock Creek enters the eastern fork of Willow Creek's Brushy Fork. When the water level came up, this ditch also flooded and entered Brushy Fork. When the stream was sampled on June 16, 2005, a ripe male rainbow trout was captured in the same pool with a ripe female cutthroat and two other ripe male cutthroat. The female cutthroat had not yet spawned, and in subsequent sampling a week later, a redd was found in the location where the fish were captured. No other rainbow trout were captured in 2005, but genetic samples were collected again from the creek, along with fin clips from several age-0 fish. Threats of competition and predation by brook trout and the threat of rainbow introgression increase the urgency to preserve this population of cutthroat trout.

Mountain Stream Sampling

Mountain Stream Crew

Working in cooperation with the USFS, a 2-person crew was hired during the summer of 2002 to survey the streams of the Absaroka-Beartooth Mountains. The goal was to document the current populations of YCT, identify new populations of fish, and identify fishless streams with suitable habitat for the potential introduction of cutthroat trout. Results of these surveys are summarized in Appendix 2.

Whirling Disease Sampling

In the fall of 2003 whirling disease was confirmed for the first time in Region 5 in the Clarks Fork of the Yellowstone River. Wyoming reported an outbreak of the disease, and testing in the fall of 2003 indicated the disease had migrated into Montana. To determine the distribution of the disease and the severity of infection, many waters across the area were tested. In October 2004, 21 live car cages containing age-0 rainbow trout were placed in the Clarks Fork of the Yellowstone, Rock Creek, and the Yellowstone, Boulder, and Stillwater rivers. After incubating the cages of fish for 7-10 days, the fish were removed and incubated for an additional 3 months in the laboratory before being tested for the disease. If the disease is not present, the individual fish is assigned an infection score of 0 (Table 24). If the disease is present, the severity of the infection is ranked on a scale of 1-5, with 5 being the most severe. In general, 50 fish are placed in live cars and tested later for the disease.

Table 24. Results of whirling disease testing from various streams across Region 5 and Wyoming during the fall of 2004.

				Infection Score					
Stream	Location	Latitude	Longitude	0	1	2	3	4	5
Clarks Fork (WY)	US Bennett Creek			48	1	1	0	0	0
Bennett Creek				0	0	0	0	0	50
Clarks Fork	At state line	45.0068	109.08138	4	2	8	13	13	10
Clarks Fork	Robinson Draw Rd.	45.02833	109.06068	5	5	9	14	15	2
Clarks Fork	2 mi DS Robinson Rd	45.05428	109.07013	22	4	3	1	2	0
Clarks Fork	Near Bridger	45.29624	109.90013	48	2	0	0	0	0
Clarks Fork	2.5 mi US Fromberg	45.35937	109.91360	50	0	0	0	0	0
Clarks Fork	Near Edgar	45.46363	108.83929	50	0	0	0	0	0
Bluewater Creek	US hatchery			50	0	0	0	0	0
Bluewater Creek	At the hatchery outlet			50	0	0	0	0	0
Bluewater Creek	Mouth at Clarks Fk.			50	0	0	0	0	0
Rock Creek	Beaver Lodge FAS			34	0	0	0	0	0
Rock Creek	Joliet			23	0	0	0	0	0
Rock Creek	Fort Rockvale			50	0	0	0	0	0
Rock Creek	Mouth at Clarks Fk.			50	0	0	0	0	0
Boulder River	Big Timber			50	0	0	0	0	0
Stillwater River	Fireman's Point FAS			49	1	0	0	0	0
Yellowstone River	Grey Bear FAS			44	3	2	1	0	0
Yellowstone River	Bratten FAS			50	0	0	0	0	0
Yellowstone River	Columbus			42	0	0	0	0	0
Yellowstone River	Buffalo Mirage FAS			50	0	0	0	0	0
Yellowstone River	Duck Cr. Bridge			50	0	0	0	0	0

The data from the Clarks Fork of the Yellowstone indicate the most severe infection occurred in Wyoming near Bennett Creek. Upstream of Bennett Creek the disease is present, but at low levels. Within Bennett Creek, and in areas downstream, the infection is quite severe. The infection rate appears to decrease dramatically in a downstream fashion, and is not present in the river between Bridger and Fromberg or areas downstream. No disease was detected in Bluewater Creek upstream or downstream of the hatchery, nor was the disease present in Rock Creek. The

high infection rate near the state line is of particular concern. Very little natural reproduction of trout occurs in the Clarks Fork in Montana, but native whitefish, which are also susceptible to the disease, may be affected. Anecdotal information from anglers indicates that numbers of whitefish, particularly juveniles, have declined dramatically over the past 3 years. The whitefish fishery in the Clarks Fork is highly valued by local anglers, so the potential impacts of whirling disease could be severe.

No whirling disease was detected in the Boulder River, yet the disease was present at Grey Bear Fishing Access on the Yellowstone, approximately 12 miles upstream (Table 24). The cage placed at Otter Creek Fishing Access Site was tampered with and the fish were lost. Downstream of Grey Bear to Duck Creek Bridge in Billings, the disease was not detected, except in the Stillwater River near its mouth. At this location only 1 fish tested positive for the disease and it was a minor infection.

In 2005, additional whirling disease testing was done in the Boulder and Stillwater rivers near known spawning areas. The results of these tests were not available for inclusion in this report.

MANAGEMENT RECOMMENDATIONS

1) Continue to monitor the Yellowstone, Boulder, and Stillwater river drainages to determine the effects of drought, flooding, disease (especially whirling disease), fishing pressure, and management changes on fish populations. Maintain the current regulations on lower Boulder and Stillwater rivers of 2 fish, only one over 13 in, as lower limits have likely led to a more stable fishery given the high fishing pressure and drought. Pursue studies and funding of fish entrainment in ditches in the Boulder and Stillwater rivers, and look for ways to reduce fish loss in ditches.

2) Conduct population estimates in the Laurel Section of the Yellowstone River to determine effects of drought on the fishery.

3) Continue spawning evaluations in Esp Spring Creek, and electrofish the stream to determine if juvenile cutthroats are present. Pursue opportunities to improve habitat for spawning fish, such as introduction of gravels and development of holding/spawning pools. Pursue other options for introducing Yellowstone River cutthroats into the creek to establish a spawning run. Continue to evaluate other spring tributaries to the Yellowstone River for restoration potential.

4) Continue to work with the Forest Service, DNRC and private lands Yellowstone cutthroat biologist to secure the Yellowstone cutthroat population in Lower Deer Creek downstream from the falls. Work to construct a barrier on state lands downstream of the National Forest. Monitor the introduced population above falls to determine success of plants, dispersion from the point of stocking and natural reproduction. Survey the West Fork of Lower Deer Creek at low water to determine habitat suitability for possible introduction of cutthroat trout.

5) Identify potential barrier locations on Upper Deer Creek to prepare to restore the dwindling cutthroat population. Inventory the watershed to determine the current distribution of cutthroats and other species of fish.

6) Continue brook trout removal efforts on Soda Butte Creek for a minimum of 2 additional years, then evaluate whether future removal would be beneficial.

7) Work with Yellowstone National Park to determine how best to protect the population of cutthroat trout in Soda Butte Creek, including the possibility of cutthroat restoration in the Buffalo Fork of Slough Creek.

8) Prepare an EA and begin a project to replace the existing fishery in Four Mile Creek, Silver Lake and Prospect lakes with Yellowstone cutthroat trout in order to protect cutthroats in Meatrack Creek. Continue to monitor potential fish passage in lower Four Mile Creek to determine if a barrier is needed to keep rainbow trout from migrating upstream into Four Mile Creek.

9) Continue the inventory of the upper Boulder River to determine the current range and genetic status of cutthroat trout.

10) Continue to monitor trout spawning at Beaver Meadows for continued impacts of bank stabilization on spawning areas. Correlate spawning data to population counts in the Boulder and Yellowstone rivers.

11) Monitor Bad Canyon Creek for the presence of non-native brown trout upstream of the barrier falls and to determine if stocked fish have spawned in 2006.

12) Continue the inventory of Goose Creek drainage to determine the extent of habitats occupied by brook trout. Prepare an EA for the removal of brook trout in Huckleberry, Mutt and Jeff lakes, and in Goose Creek from the most upstream barrier to the confluence with the Stillwater River.

13) Obtain funding for and design a creel/recreational survey on the Stillwater River to determine the amount and types of uses and fishing pressure/harvest. Perform a similar survey on the Yellowstone River to determine fish harvest and whether there is evidence of increasing fishing pressure and high harvest rates due to liberal number-and size-limits.

14) Continue the tagging study and summarize results to help identify fish movements, catch and harvest rates in the Boulder, Stillwater, Clarks Fork and Yellowstone rivers.

15) Continue brook trout suppression efforts on the Brushy Fork of Willow Creek and work to find/create habitats suitable for the eventual transplant of cutthroats from the creek. Emphasis should be placed on finding/creating fishless habitat in Beartooth Face streams with similar habitat and climate. Continue the genetic monitoring to determine if rainbow trout have invaded the stream.

16) Work with the biologist responsible for cutthroat work on private lands to develop restoration projects that will benefit YCT on private lands in R5.

17) Continue collecting fisheries information from the Clarks Fork River to assist in developing a fishery there and to assist with native species management. Work to provide fish passage at diversion dams on the Clarks Fork and Rock Creek, and at impassible stream crossings on tributary streams. Discuss the option to introduce YCT into Line Creek. Monitor the Clarks Fork for the presence of whirling disease detected in Wyoming, and determine the impact on the trout and whitefish fishery.

18) Continue the cooperative project with USFS to eliminate brook and westslope cutthroat trout from the headwaters of Soda Butte Creek. Restock the chemically treated tributary with Yellowstone cutthroat trout from the Yellowstone River Trout Hatchery at Big Timber. Continue stocking Miller and Sheep creeks for an additional 2 years with Goose Lake strain of cutthroat.

19) Continue to work with the USFS to identify streams in the Absaroka-Beartooth Mountains that contain cutthroats, and fishless streams that are suitable for cutthroat introduction. Pursue opportunities to rehabilitate streams and lakes to convert them from non-native species to YCT.

20) Continue to monitor streams in Region 5 for the presence of whirling disease.

Prepared by: James R. Olsen

Date: 3/08

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WATERS REFERRED TO:

Bad Canyon Creek
Big Timber Creek
Boulder River (Beaver Meadows)
Boulder River (B2)
Buffalo Fork of Slough Creek
Burnt Fork of Red Lodge Creek
Brushy Fork of Willow Creek
Clear Creek (Rock Creek)
Clarks Fork of the Yellowstone River
East Boulder River
East Boulder River (Placer Basin)
East Fork of the West Fork of Red Lodge Creek
Esp Spring Creek
Elk Creek (East Boulder)
Fishtail Creek (West Rosebud)
Four Mile Creek (Boulder)
Goose Creek (Stillwater River)
Great Falls Creek (Boulder)
Harney Creek (Red Lodge Creek)
Hogan Creek (Red Lodge Creek)
Iron Creek
Little Rocky Creek
Little Timber Creek
Lower Deer Creek
Meatrack Creek (Boulder)
Miller Creek
Morse Creek (East Rosebud)
Picket Pin Creek
Placer Gulch (Lower Deer Creek)
Red Lodge Creek
Rock Creek
Sage Creek (Big Horn River)
Sheep Creek
Soda Butte Creek (Lamar River)
Stillwater River
Upper Deer Creek
Upside Down Creek
Willow Creek (Red Lodge Creek)
West Boulder River
West Fork Lower Deer Creek
West Red Lodge Creek
West Rosebud Creek
Wyoming Creek
Yellowstone River

Appendix 1 – Aquatic Invertebrate Data From Soda Butte Creek

Appendix 1. Invertebrate data collected from Soda Butte Creek in conjunction with the rotenone treatment during 2004 and 2005. The Control site was located downstream of the detoxification area in Soda Butte Creek (near the middle of the Soda Butte Campground) and the treatment site was located near the Fisher Creek Road culvert over the unnamed tributary to Soda Butte Creek. Invertebrates were collected using a kick net on a diagonal transect across the stream bed (DEQ 2004).

	ABUNDANCE					
Taxonomic Group	Control-pre	Control-post	Control-post 1 year	Treat-Pre	Treat-Post	Treat-Post 1 Year
EPHEMEROPTERA (mayflies)						
Baetidae						
Acentrella insignificans	23	2	23	9		18
Pseudocloeon edmundsi		1	96	1		25
Ephemerellidae						
Drunella coloradensis	3	2	5			
Drunella doddsi	3	1	10			1
Drunella spinifera				1		
Serratella tibialis	27	176	6		1	4
Heptageniidae						
Cinygmula sp.	22	39	493			140
Epeorus deceptivus	4		1			
Heptagenia sp.	198	811	8	16		6
Rhithrogena sp.		2	1	2		
Siphlonuridae						
Ameletus sp.		3	1	4	5	23
Totals:	280	1037	644	33	6	217
PLECOPTERA (stoneflies)						
Capniidae						
Immature		9	8			
Leuctridae						
Immature		4				
Chloroperlidae						
Sweltsa sp.	10	20	11	32	1	38
Nemouridae						
Zapada cinctipes		1	3	67		84
Zapada Oregonensis Grp.		1		14		
Immature		4	3			
Perlidae						
Doroneuria theodora			1	5		73
Perlodidae						
Kogotus modestus	1					
Megarcys sp.	2	10	11	5		11
Setvena bradleyi	1					
Immature	1	10	12	10		70
Totals:	15	59	49	133	1	276

Taxonomic Group (Cont.)	Control-pre	Control-post	Control-post 1 year		Treat-Pre	Treat-Post	Treat-Post 1 Year
TRICHOPTERA (caddisflies)							
Hydropsychidae							
Parapsyche elsis			1				
Limnephilidae							
Dicosmoecus sp.							2
Immature		9	7				
Rhyacophilidae							
Rhyacophila angelita Grp.							1
Rhyacophila vaccua							36
Rhyacophila vemna/Brunnea Grp.			3		12	2	21
Rhyacophila vepulsa			1		4		4
Rhyacophila verrula		3	7			1	1
Rhyacophila sp.		1	1				5
Totals:	0	13	19		16	3	68
COLEOPTERA (beetles)							
Elmidae							
Cleptelmis sp.					4	1	
Heterlimnius corpulentus							2
Totals:	0	0	0	0	4	1	2
DIPTERA (true flies)							
Ceratopogonidae	2	2	2		5		3
Chironomidae	206	152	820		118	68	249
Dixidae							
Dixa sp.							1
Empididae							
Oreogeton sp.			3				1
Oreogeton sp.							
Muscidae							
Limnophora sp.			4				
Psychodidae	3	9	4		1		1
Tipulidae							2
Dicranota sp.	3	9	1		4	1	1
Tipula sp.						1	14
Totals:	214	172	834		128	70	272
NON-INSECT TAXA							
Turbellaria (flatworms)	2		1				
Annelida							
Oligochaeta (earthworms)	2		2				1
Ostracoda			3		37		540
Totals:	4	0	6		37	0	541
TOTAL INDIVIDUALS	**1022**	**2562**	**3099**		**665**	**162**	**2213**

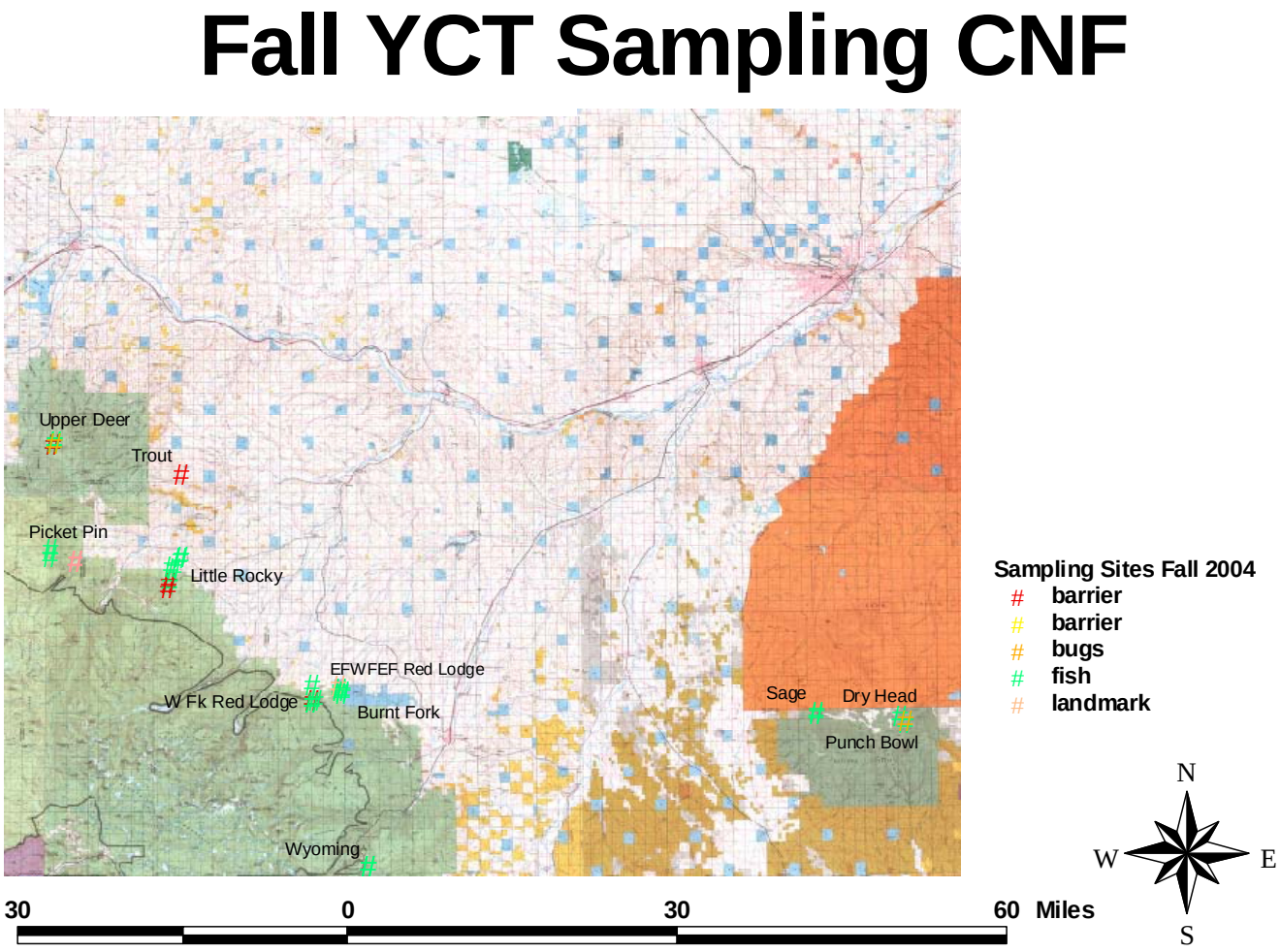
APPENDIX 2

Mountain Stream Sampling Report

Summary of work completed under the cost share agreement with the US Forest Service, Custer National Forest and Montana Fish, Wildlife and Parks during 2004.

March 2005

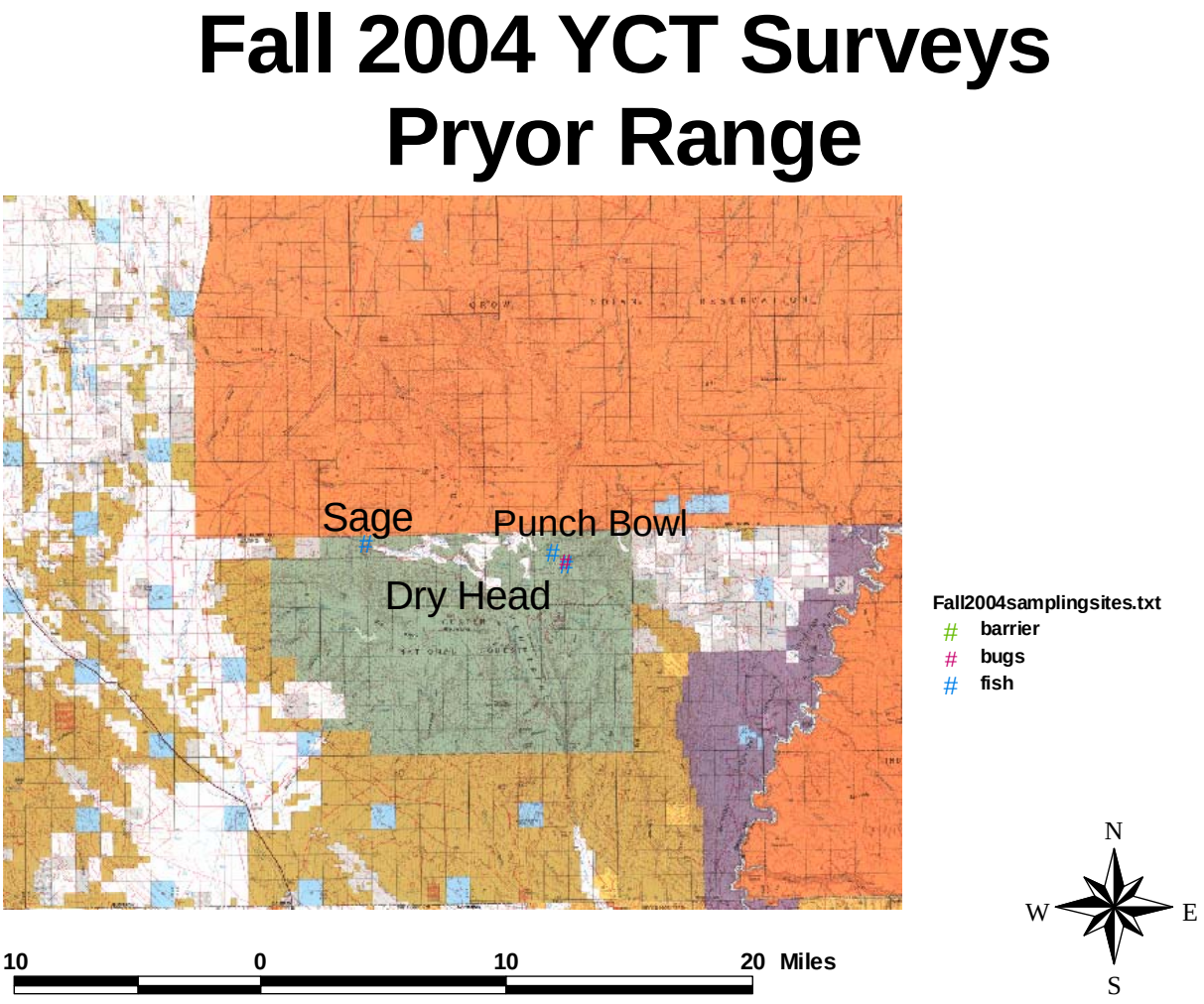
A 2-person crew surveyed a total of 11 streams during the fall of 2004 (Map 1). The emphasis of the survey was to update existing knowledge of the presences/absence and population status of Yellowstone cutthroat trout (YCT) on the Custer National Forest (CNF). This crew collected fish using backpack electrofishing. In one instance, visual observation data were collected from the bank. Fisheries data collected included fish species composition, size, and relative density. Additionally, two known fishless streams



Map 1. Detail of sampling locations on the Custer National Forest.

were surveyed to determine if the habitat conditions were suitable for possible introduction of YCT; macro-invertebrates were collected from one of these streams. Barrier falls were noted during the surveys, and GPS coordinates were recorded for all sites except Iron Creek. Fin clips were collected from YCT captured. These samples were sent to the University of Montana Genetics Lab for analysis of purity (results are not yet available). A redd census was performed on West Rosebud Creek in an attempt to quantify spawning use in a reach of stream as part of a larger project involving the relicensing of Mystic Lake Dam and Powerhouse.

Three streams were surveyed in the Pyror Mountains on the CNF (Map 2.) Dry Head Creek, previously fishless, was stocked with YCT in 2000 and 2003. During 2000, eggs from McBride Lake were incubated in remote streamside incubators and released into the creek. In 2003, 4-in LeHardy Rapids YCT were introduced into the stream. The crew visually inspected the creek for the presence of YCT and to determine how far from the stocking location the fish had dispersed. YCT were found to have migrated upstream into



Map 2. Detail of Pryor Mountains and sampling and barrier locations during 2004.

the forks of the creek from where they were stocked, and also downstream to at least the boundary of the Crow Indian Reservation. The YCT planted in 2000 should have matured and spawned for the first time in 2004, but no electrofishing was performed in the creek. Future surveys will be necessary to determine if the YCT have successfully reproduced in the creek.

Sage Creek and Punchbowl Creek in the Pryor Mountains were also surveyed. Sage Creek was stocked with YCT in the past, but currently has a robust population of brook (EB) and some rainbow (RB) trout (Fredenberg et al. 1985). A 500-ft section of the creek was electrofished near the CNF boundary (section start N 45.12782, W108.33250). During the single-pass electrofishing, no YCT were found (Table 1), but there appears to be a robust population of brook and rainbow trout. In 1984, the proportion of brook trout to rainbow trout was 7:1, but currently the proportion is 1.4:1; however, the average size and size range of fish is very similar. Sage Creek is being considered as a candidate location for non-native fish removal and YCT restoration. The upper reaches of Punchbowl Creek (N 45.11931, W 108.23356) have been presumed fishless and a candidate location for YCT. Electrofishing in the reach confirmed that the area is fishless. A kick sample of stream macroinvertebrates was collected to determine the species community composition. This sample is currently being analyzed. Although flows were relatively low, the habitat conditions in the creek appeared suitable for YCT.

Table 1. Fish captured from Sage Creek during 2004 surveys.

Sage Creek				
Species	# Fish	Average L (in)	Max L (in)	Min L (in)
RB	15	7.3	9.5	5.2
EB	21	5.8	8.9	3

Figure 1. Habitat in Wyoming Creek downstream from Wyoming-Montana state line.

A previously undiscovered population of YCT was sampled in Wyoming Creek in the Rock Creek drainage. The origin of this population of fish is unknown, but it is unlikely that it is a native population of fish because of barriers located between its confluence with Rock Creek and where the current population is located, approximately 2 miles upstream (Figure 1, N45.00796, W109.23343). It is possible that fish were stocked into a lake in Wyoming at the head of the drainage, and those fish have since populated the creek. There are no YCT presently in the lake, and a barrier falls downstream of the lake precludes upstream passage. Twenty-eight YCT were captured from the creek (Table 2, Figure 2). Data from electrofishing suggest the population of fish is not large, but natural reproduction is occurring, and adult fish are relatively large in size.

Table 2. Electrofishing results from Wyoming Creek, 2004.

Wyoming Creek Species	# Fish	Average L (in)	Max L (in)	Min L (in)
YCT	28	8.6	14.0	3.3

Figure 2. YCT from Wyoming Creek.

Several streams in the West Red Lodge Creek drainage have historically contained populations of pure YCT. West Red Lodge Creek was sampled at the forest boundary with private land (N45.15201, W109.27192), at the wilderness boundary (45.13901, W109.24649), and upstream of a 20-ft barrier falls (45.13993, W109.29394) within the wilderness. Brook and brown trout were present at the forest boundary (Table 3), but no fish were captured upstream or downstream of the barrier within the wilderness area. No YCT were found. YCT were stocked in the stream in 1980 and 1982 at the forest boundary, and reproduction appeared to be occurring (Fredenberg et al. 1985). In 1984, brook trout outnumbered brown trout 20:1, but currently the population of fish is approximately 50% of each species. Rainbow trout were also historically present at the site in low numbers, but none were captured during 2004.

Figure 3. East Fork of the West Fork of Red Lodge Creek, 2004.

A single electrofishing pass was made in a 1000-ft section of the East Fork of the West Fork of Red Lodge Creek (Figure 3) (N45.14816, W109.26571), and YCT and brook trout were found (Table 3). Although small, YCT were much more abundant than brook trout in the creek. At last sampling in 1994, no fish were present in the creek (Poore 1997). A 500-ft section of the Burnt Fork of Red Lodge Creek (a tributary to the East Fork of the West Fork Red Lodge Creek) was also sampled (N45.14613, W109.26294), and only brook trout were captured. Because YCT inhabited the creek historically, approximately 1 mile of stream was spot shocked, but no YCT were found. Further investigation in the Burnt Fork of Red Lodge Creek is necessary to determine if YCT are no longer present. The East Fork of the West Fork of Red Lodge Creek and the Burnt

Fork may be candidates for brook trout removal and YCT restoration, pending results from genetic analysis.

Table 3. Electrofishing results from the West Fork of Red Lodge Creek and tributaries.

West Fork of Red Lodge Creek (at forest boundary)				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
Brown trout	8	10.4	13.8	5.5
Brook trout	9	7.8	9.9	5.8
East Fork of the West Fork of Red Lodge Creek				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
YCT	16	3.9	5.5	3.3
Brook trout	3	5.5	6	4.6
Burnt Fork of Red Lodge Creek				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
Brook trout	38	4.65	8.2	2.4

Four streams were sampled in the Stillwater River drainage: Little Rocky Creek, Picket Pin Creek, Iron Creek, and Trout Creek. Little Rocky Creek (Figure 4) historically contained a population of likely indigenous YCT (Marcuson 1976), rainbow and brown trout within one mile of the forest boundary; however, more recent fish surveys of the area found no YCT and no other species of fish (Poore 1997). Four sections of the creek were sampled to determine YCT presence and distribution in the drainage.

Figure 4. Little Rocky Creek, Custer National Forest. 2004.

Figure 5. YCT from Little Rocky Creek

The farthest upstream sampling location began near the old mine site (N45.23103, W109.45652) and extended upstream 2500-3000 ft. The stream was intermittently electrofished until there was too much ice on the creek to effectively sample. YCT (Figure 5) and brown trout were present in the creek in relatively equal numbers (Table 4). The upstream extent of the fish distribution was not determined because of the ice. The second section began at the Benbow Road crossing and extended upstream 500 ft (N45.23287, W109.45498). YCT outnumbered brown trout in this reach of creek. The third sampling location was downstream of the National Forest on the Beartooth Christian Ranch

(N45.24497, W109.45138). A 1000-ft section was sampled, and only 1 YCT was captured: 36 brown trout were captured (Table 4). The last section sampled was on the Kirch Ranch downstream of the Beartooth Christian Ranch. No YCT and 18 brown trout were captured. These data suggest there is a relatively abundant, self-sustaining population of YCT in Little Rocky Creek. Previous data suggested that YCT in the creek had been extirpated, but our data indicate that they have recovered to some degree. The data also indicate that the abundance of YCT declines farther downstream. This stream may be a good candidate for YCT restoration and removal of brown trout, pending information about the genetic purity of the population.

Table 4. Results of electrofishing surveys in Little Rocky Creek, 2004.

Little Rocky Creek Upstream of Old Mine Site				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
YCT	14	6.7	9.4	2.6
Brown trout	12	8.5	10.6	4.3
Little Rocky Creek Upstream of Benbow Road				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
YCT	23	6.1	9	2.5
Brown trout	15	8.4	11.8	4
Little Rocky Creek at Beartooth Christian Ranch				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
YCT	1	8.8		
Brown trout	36	7.1	11.7	2.5
Little Rocky Creek at Kirch Ranch				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
Brown trout	16	5.6	9.5	3.1

Iron and Picket Pin creeks have historically contained populations of YCT. Iron Creek is a tributary to the West Fork Stillwater River. The stream was accessed by descending Iron Mountain from the Brass Monkey Mine site. The stream was electrofished where there was sufficient water (no GPS point was taken). Only YCT were captured in the creek (Table 5), and the size distribution of fish indicates that natural reproduction is occurring in the creek. Rainbow trout have been found historically near the confluence with the West Fork (Marcuson 1976), but it is unclear if this population is still present. Genetic samples collected from YCT in 1993 confirmed the fish were pure-strain (Poore 1994). Future sampling is necessary in Iron Creek to determine the distribution of YCT downstream toward the confluence with the West Fork Stillwater River, whether there are barriers in the system, and whether any hybridization with rainbow trout is occurring.

Picket Pin Creek flows into Limestone Creek, which is a tributary to the West Fork Stillwater River. The creek has historically contained a population of YCT that was

slightly hybridized with rainbow trout (Poore 1997) in its upper reaches, and brown trout near its confluence with Limestone Creek. Fluvial artic grayling were stocked at one time in the creek (Fredenberg et al. 1985). A 1000-ft section of the creek was electrofished at the crossing on Picket Pin Road (N45.25877, W109.59050). Electrofishing efficiency was low due to high water velocity, low conductivity, and deep pools. Only YCT were found in the stream; no grayling were captured. Picket Pin Creek may be a candidate stream for YCT restoration because of apparent natural barriers on the CNF and on private land (there are no brown trout at the sampling location on the CNF), and the presence of pure YCT in Picket Pin Lake farther upstream. Future surveys are needed to determine the location of the barrier(s) in Picket Pin Creek, the extent of the YCT population upstream and downstream of the sampling location, and whether grayling are present.

Table 5. Electrofishing data from Iron and Picket Pin creeks, 2004.

Iron Creek				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
YCT	14	5.6	8.8	3.6
Picket Pin Creek				
Species	# fish	Average L (in)	Max L (in)	Min L (in)
YCT	16	7.4	10.6	3.5

Trout Creek is a tributary to the Stillwater River. The creek contains populations of brown and brook trout on the CNF, but there is a large 10-ft barrier waterfall at the upper end of the creek (N45.31853, W109.44346). The creek is fishless from this point upstream. Trout Creek was investigated for the potential of introducing YCT into this fishless reach and found to be dry upstream of the barrier falls; therefore, it is not a candidate for YCT introduction.

A redd survey was conducted in West Rosebud Creek from the Pine Grove Campground (on the CNF) downstream approximately 5 miles on October 27, 2004. This survey was conducted to determine the use of this reach by resident and potentially migratory brown trout, as part of gathering information germane to relicensing Mystic Lake Dam and power plant. Several brown trout redds were present in the reach, with the majority concentrated in the section of stream from the upper bridge on the Mackay Ranch to the Pine Grove Campground (Table 6). A similar redd survey will be conducted during the spring to determine use of the reach by rainbow trout.

Table 6. Locations of redds in West Rosebud Creek on 10/27/04.

Redd Location	# Of redds
N 45 20.518 W 109 36.040	4
N 45 20.504 W 109 36.080	1
N 45 20.475 W109 36.105	1
N 45 20.402 W 109 36.194	1
N 45 19.903 W 109 36.202	2
N 45 19.688 W109 36.112	1
N 45 19.225 W 109 36.275	3
N 45 19.031 W 109 36.340	1
N 45 18.309 W 109 36.850	1
N 45 17.668 W 109 37.060	1
N 45 17.560 W 109 37.142	2
N 45 17.464 W 109 37.168	1
N 45 17.376 W 109 37.376	1
N 45 17.233 W 109 37.435	1
N 45 17.116 W 109 37.469	3
N 45 17.079 W 109 37.467	1
N 45 17.025 W 109 37.553	2
N 45 17.014 W 109 37.560	1
N 45 16.929 W 109 37.753	1
N 45 16.927 W 109 37.844	1
N 45 16.880 W 109 38.028	1
Total	31

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